AN EOCENE LEATHERBACK TURTLE
(CRYPTODIRA: DERMOCHELYIDAE)
FROM SEYMOUR ISLAND,
ANTARCTICA.

MARCELO S. DE LA FUENTE (*)
SERGIO N. SANTILLANA (**) 
SERGIO A. MARENSSI (**) 


Palabras clave: Península Antártica, Eoceno, Chelonii, Dermochelyidae, Sistemática.

Key words: Antarctic Peninsula, Eocene, Chelonii, Dermochelyidae, Systematic.
RESUMEN: Se describen los primeros restos fosiles de tortugas Dermochelyidae en la Península Antártica. Los mismos proceden de afloramientos de la Formación La Meseta (Eoceno) en tres localidades de la Isla Marambio (Seymour). Los materiales fósiles consisten en placas aisladas y un pequeño fragmento de la coraza, de naturaleza epitecal, correspondientes a diversos especímenes. Esta armadura epitecal es sólo conocida entre los miembros de la familia Dermochelyidae registrados desde el Eoceno medio hasta la Actualidad. Los especímenes antárticos son tentativamente referidos al género Psephophorus, taxón cuyas especies se registran desde el Eoceno medio - superior hasta el Plioceno en Europa, Nueva Zelanda y América del Norte.

ABSTRACT: The outcrops of La Meseta Formation from Seymour Island yielded the first Antarctic fossil remains of Dermochelyid. It consist of isolated platelets and a small portion of the shell of epithelial nature. This epithelial armor is only known in Middle-Upper Eocene to Recent members of the family Dermochelyidae among the turtles. The Antarctic specimens are tentatively referred to Psephophorus, a genus whose species are recorded from Middle - Upper Eocene to Pliocene of Europe, New Zealand and North America.

INTRODUCTION

During the last six summer Antarctic Expeditions of the Instituto Antártico Argentino, field work was carried out by geologists of this Institution (IAA) and paleontologists of the Departamento Científico Paleontología Vertebrados, in five land mammal-bearing localities with outcrops of La Meseta Formation (Eocene), Seymour Island, Antarctic Peninsula (Fig.1). Several vertebrate remains as Chondrichthyes, Osteichthyes, Aves, Marsupials and placental mammals were found in those localities (see MARENSSI et al., 1994, and references therein).

Although the probable record of pleurodiran turtles in Antarctic Peninsula has been previously cited (WOOD in PRITCHARD, 1974; FUENTE in MARENSSI et al., 1994) its presence has never been proved. In this article, the first record of cryptodiran turtles of Antarctica is documented. Remains of these turtles were collected in three mammal-bearing localities (DPV 6/84 = RV-8200, DPV 2/84 and IAA 1/90)(Fig.2) and are referred to Family Dermochelyidae. This family of leatherback turtles is represented by the living species Dermochelys coriacea (Linnaeus, 1766) and by several Eocene to Pliocene taxa.

The material used in this study is housed in the Departamento de Paleontología Vertebrados of the Museo de La Plata (MLP), La Plata, Argentina.
GEOLOGICAL SETTING

The Eocene La Meseta Formation consists of approximately 720 m of poorly consolidated shallow marine, estuarine and deltaic sedimentsites (MARENSSI, unpublished data). This unit rests unconformably on rocks of the Maastrichtian-Paleocene Marambio Group (RINALDI et al, 1978) and also upon the the Upper Paleocene Cross Valley Formation (ELLIOT & TRAUTMAN, 1982). The Eocene sediments fill a broad channel or canyon- like trough cut subareously but filled after a marine transgression (MARENSSI & SANTILLANA, 1994).

ELLIOT & TRAUTMAN (1982) divided the La Meseta Formation into three informal members designated I to III from base to top. Lately, SADLER (1988) subdivided this unit into seven major lithofacies (TELM 1 to 7) with seven minor subunits. Finally, MARENSSI & SANTILLANA (1994) indicated that La Meseta Formation is a depositional sequence and can be divided into six unconformity-bounded units or informal Allomembers.

Localities DPV 6/84 (RV-8200 or The Mammal Site, WOODBURNE & ZINSMEISTER, 1984), DPV 2/84 and IAA 1/90 (The Ungulate Site, MARENSSI et al, 1994) are situated in the middle part of the formation into Member II of ELLIOT & TRAUTMAN (1982), TELM 4-5 of SADLER (1988) or Allomember Cuccullaea I of MARENSSI & SANTILLANA (1994) (Fig. 3). This section consists of thick shelly conglomerates, well sorted fine sands and interlaminated sand-mud channel fills.
The coquina marking the base of this unconformity-bounded unit where locality DPV 2/84 is located, is TELM 4 of Sadler (1988). It has an erosive base, a maximum thickness of 4 m and can be traced laterally for several kilometers. The macrofauna is dominated by the robust pelecypod Cucullaea raea but marine and terrestrial remains also occur. Locality IAA 1/90 occurs in a thin shelly conglomerate within the sand/mud lithofacies in the middle part of the allomember. The macrofauna is dominated by naticid gastropods, but remains of land and marine vertebrates are also present. Finally, locality DPV 6/84 is situated near the top of this unconformity-bounded unit immediately below a hummocky bedded thick sand. Marenssi et al., (1994) and Marenssi (unpublished data) indicate that this part of the formation represents a tide-dominated and wave-influenced estuary. Terrestrial and marine organisms have been concentrated in this transitional environment by sedimentological and sometimes biological processes and hence they reflect communities that lived in different habitats and perhaps different times.
Figure 3. a. Stratigraphic section of the La Meseta Formation, Seymour Island, Antarctic Peninsula. b. Stratigraphic section of the TELM 4/5 units showing the distribution of fossil turtles localities within them.
SYSTEMATIC PALEONTOLOGY

Order *Cheloniidae* Brongniart, 1800

Infraorder *Cryptodira* Cope, 1868

Duperfamily *Cheloniioidea* Baur, 1893

Family *Dermochelyidae* Gray, 1825


**Material**: MLP 88-I-1-354 (RV-8200, TELM 5), an isolated epithecal plate; MLP 90-I-20-270/273, two isolated plates (IAA 1/90, TELM 5); MLP 92-II-2-113, a fragment of an epithecal plate (DPV 2/84, TELM 4), MLP 94-III-15-28 a fragment of epithecal corace with four plates [Coquine of Miles (DPV 2/84), TELM 3/4]; MLP 95-I-10-11/12/13, fragments of epithecal plates (IAA 1/90, TELM 5).

**Localities**: Fossil turtles have been collected in three localities: DPV 6/84 (= RV-8200), DPV 2/84 and IAA 1/90. These localities have been described by MARENSSI et al. (1994: pag. 5-6) (Fig. 2). Abbreviations: DPV 2/84, 6/84 = fossil vertebrate and flora localities of the Departamento Científico de Paleontología Vertebrados, Museo de La Plata; IAA 1/90 = fossil mammal localities of the Instituto Antártico Argentino (Dirección Nacional del Antártico); RV-8200 = fossil vertebrate and flora localities of the Department of Earth Sciences, University of California at Riverside.

**Horizons**: TELM [= Tertiary Eocene La Meseta stratigraphical units, see SADLER (1988)] 3/4/5
Figure 4. Isolated platelet from the epithecal shell of Seymour Island specimens: A (MLP 90-1-20-270), B (MLP 90-1-20-273), C (MLP 88-1-1-354), D (MLP 95-1-10-12), E (MLP 95-1-10-13), F (MLP 92-II-2-113), G fragment of 4 platelets (MLP 94-III-15-28).
DESCRIPTION AND MEASUREMENTS

The material consists of several platelets belonging to different specimens. These platelets fill the interval between consecutive ridges, forming a characteristic mosaic of smaller plates without keeled platelets.

Specimen MLP 88-1-1-354 (Fig. 4, C) is a polygonal irregular plate delimited by 9 sides. The maximum plate length is 31 mm, and 18 mm thick. The dorsal surface is smooth and in ventral view it has small capilar holes.

Specimen MLP 90-I-20-270 (Fig. 4, A) is an octagonal plate (26 mm length x 11 mm thick) and MLP 90-I-20-273 (Fig. 4, B) is pentagonal (24 mm length x 12 mm thick). Both bones are characterized by a smooth dorsal surface.

Specimen MLP 92-II-2-113 (Fig. 4, F) is a small fragment of an isolated platelet (19 mm length x 8 mm thick) with a smooth outer surface.

Specimen MLP 94-III-15-28 (Fig. 4, G) is a small fragment of epithecal armor-plating (64 mm in length) with four irregular plates of different sizes. Plates are closely fitting and upon outer surfaces the sutures are sinuous. The thickness of the epithecal bones is 14 mm.

Specimen 95-I-10-12/13 (Fig. 4, D-E) are two isolated irregular platelets that show on their dorsal surface a slightly radial decoration comparable with that present in several plates of *Psephophorus polygonus* figured by Seeley (1880: plate XV, 1). This platelets are smaller (22 mm) and less thick (6 mm) than the other Antarctic platelets described above.

REMARKS

The situation of the isolated plates within the shell can not be determined. Unlike *Dermochelys coriacea*, in other fossil taxa such as *Psephophorus* (see Seeley, 1880; Dollo, 1888; Palmer, 1909) the epithecal plates cover all the plastron. Differences in size and thickness among the plates in Seymour material could be showing different positions on the armor. After Weems (1974) and Broin & Pronon (1980) in *Psephophorus calvertensis* Palmer, 1909, the plastral platelets are thicker than the dorsal ones, while in *P.rupeliensis* (Van Beneden, 1883) the plastral plates are thinner (see Dollo, 1888). Weems (1974) also pointed out that in *P.calvertensis* the platelets of the outer and posterior edges are much smaller and thinner than the other ones.
DISCUSSION

The assignment of the isolated plates and the small armor-plating of Antarctica to the family Dermochelyidae is made by comparison with a portion of the carapace of the living leatherback turtle Dermochelys coriacea (Fig. 5). This species is the largest living sea turtle of the world and shows the main characters of the family Dermochelyidae. These features are: great size, absence of cornified integumentary structures, extreme reduction of the thecal bones of the carapace and plastron, strong longitudinal ridges on both carapace and plastron, development of an epithecal shell layer consisting of a mosaic of thousands of small polygonal plates. The great thecal bone reduction is unique among living cheloniids. Neural and peripheral plates are lacking. The thecal bones are restrained to the nuchal bone and a slightly lateral expansion of the ribs widely separated from each other. The plastral plates are all present except the odd entoplastron. However, they are reduced to splint-like structures, forming a marginal ring of bones surrounding a large central fontanelle. Likewise, the body is protected by an armor of leathery consistence covering the epithecal carapace.

Other unique internal characteristics of Dermochelys coriacea pointed out by Pritchard & Trebbau (1984) are: presence of a looped esophagus up to 2 m in
length, degree of endothermy, and vascularization of the cartilage (see RHODIN et al., 1981). Those peculiar morphological and physiological characteristics could be in relation with the invasion of a specific ecological niche. PRITCHARD & TREBBAU (op.cit.) consider that other sea turtles, though able to make oceanic crossing migrations, are essentially coastal forms depending for food on continental organisms, while the dermochelyids are truly pelagic. The success of the leatherbacks as true pelagic turtles is a result of the high specialization in the consumption of scyphomedusans. According to PRITCHARD & TREBBAU (1984) such diet is more easily obtainable in the necessary volume in the more productive cooler waters outside the tropics, where an advantage in a degree of endothermy would enable a reptile to inhabit the low temperatures of high latitudes. Although the nesting areas of Dermochelys coriacea is almost restricted to the tropics, the large latitudinal range of the living leatherback turtle (northernmost record 71° N and southernmost 47° S) support this statement.

Five genera have been included in the family Dermochelyidae: Cosmochelys Andrews, 1919 from the Eocene of Nigeria; Dermochelys Blainville, 1816, Recent worldwide oceanic distribution; Eosphargis Lydekker, 1889, from the Early Eocene of England, Belgium and Denmark; Psephophorus von Meyer, 1847, from the Eocene-Pliocene of Europe (England, Belgium, Czechoslovakia, Italy, France and Germany), New Zealand, North Africa and North America; Pseudosphargis Koenen, 1891, from the Late Oligocene of Germany.

Although the Antarctic material is clearly a dermochelyid, its taxonomic position within the family is obscure due to its fragmentary nature. However, the Seymour Island platelets were compared with the armor of living and fossil taxa. The genus Cosmochelys is represented by only one species: Cosmochelys dolloi Andrews, 1919. On comparing the Seymour Island platelets with the shell of the holotype of Cosmochelys dolloi ANDREWS (1919: plate II) the differences in the decoration of the plates are remarkable. Unlike our specimens, the Nigerian species shows the outer surface sculptured with a series of irregular tuberosities in the middle surrounded by radial ridges. Other characteristics of the Nigerian species, such as the slender ridges of the rows of longitudinally keeled plates and the mosaic of smaller plates placed between the ridges are only two rows of platelets, are not comparable with our material.

The differences in size, dimensions, thickness and decoration between the Seymour Island platelets and the individual plates of Dermochelys coriacea prevent the inclusion of the Antarctic specimens in the same genus and species than the living leatherback turtle.

Eosphargis is represented by two species, one of them named E.gigas (Lydekker, 1889) from the London Clay Formation (Lower Eocene), Sheppey Island, England (LYDEKKER,1889) and from the Lower Eocene of Belgium (DOLLO, 1909); and another one, E.breineri Nielsen, 1959 from the Early Eocene of
Denmark (Nielsen, 1959). The English material of E.gigas includes two specimens with skull and postcranial bones, while the Belgian one is an almost complete specimen shortly portrayed by Dollo (1909). E.breineri is known by cranial and postcranial bones described by Nielsen (1959, 1963). Both species of Eosphargis share a primitive trait such as the absence of epithecal shell, a character that makes a strong difference between Eosphargis and the more apomorphic taxa of dermochelyids (Seymour specimens included).

The genus Psephophorus H. von Meyer, 1847 includes several named species [P.polygonus H. von Meyer, 1847; P.calvertensis Palmer, 1909; P.pseudostracion (Gervais, 1849); P.rupeliensis (Van Beneden, 1883); P.eocaenus Andrews, 1901; P.scaldi (Van Beneden, 1871)] (see Mlynarski, 1976; Broin & Pironon, 1980). P.eocaenus from the Middle or Upper Eocene of Qsar El Sagha, Fayum, Egypt (Andrews, 1906) and P.scaldi from the Miocene of Anvers, Belgium (Van Beneden, 1871) are not comparable with the Antarctic specimens, because they are known by a humerus and other remains of the appendicular skeleton. P.calvertensis Palmer, 1909, from the Middle Miocene of Maryland, consists of several epithecal shell fragments. According to Palmer (1909: pl 31) the main remain is a portion of the medium ridge shell, the other shell fragments are a dorso-lateral ridge sector and a plastral piece. The plastral plates of the P.calvertensis are mostly large, thick and smooth on the dorsal surface like the largest platelets of Seymour Island specimens. The holotype of Psephophorus polygonus H. von Meyer, 1847, from the Miocene of Czechoslovakia, figured by Seeley (1880: pl. 15), consists of a median part of the epithecal shell that includes a longitudinal medial keel made of rows of large thickened plates between a mosaic of smaller circular to polygonal platelets irregularly arranged. The smaller platelets from Seymour Island could be comparable with the polygonal plates without ridges of P.polygonus. P.pseudostracion (Gervais, 1849) from the Pliocene of Vandargues (France) figured by Gervais (1872, pl 9, fig 4) according to Broin & Pironon (1980) consists of a longitudinal row of large plates and small plates at both sides. Although P.rupeliensis (Van Beneden, 1883), from the Oligocene of Belgium, is known by remains of the skull, post-cranial skeleton and carapace of several specimens, only a few elements have been figured by Van Beneden (1883) (isolated polygonal platelets, vertebrae and ilium) first, and then by Dollo (1888) (three fragments of humerus), and other specimens have never been described. According to Broin & Pironon (1980) one specimen housed in the exposition of the Royal Institut of Natural Sciences of Belgium is characterized by the large polygonal platelets.

In spite of the fragmentary nature of the Seymour Island specimens, some platelets could be comparable with the epithecal armor remains of these species. However, nothing is known about the morphology of the epithecal carapace, the arrange of the ridges and the mosaic of small platelets to make an accurate determination.

Several fragmentary materials (isolated platelets, shell fragments and appendicular skeleton) have also been referred to the genus Psephophorus from the
Miocene of Italy (BROIN & PIRONON, 1980) and Germany (DAMES, 1894), the Middle Eocene of England (LYDEKKER, 1889) and the Eocene of New Zealand (KOHLER, 1994); and there are two species that have a close relation with *Psephophorus* (see BROIN & PIRONON, 1980). One of them is *Psephophorus oregonensis* PACKARD, 1940, from the Eocene of Oregon, named upon the fragments of the carapace and skeleton. The other is *Pseudosphargis ingens* (Koenen, 1891) from the Upper Oligocene of Westphalia (Germany), which was described by DAMES (1894) upon a skull fragment. According to (NIELSEN, 1959), these two last species could be probably assigned to the genus *Psephophorus* but this statement has not been certified.

**ACKNOWLEDGEMENTS**

We would like to thank Lic. CECILIA DESCHAMPS (Museo de La Plata) for the English review; to Lic.Marcelo Reguero, Mr.Juan J. Moly and Dr. Sergio Vizcaino for their field work. Logistical support was provided by the Instituto Antártico Argentino and Fuerza Aerea Argentina.

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