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A large osteichthyan vertebra from the Eocene of Antarctica

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With 2 figures

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Abstract: A vertebra from the La Meseta Formation in Seymour Island is tentatively assigned to the rare genus *Xiphiorhynchus* (Teleostei, Perciformes, Xiphiorhynchidae. It belongs to one of the largest fossil osteichthyes ever described.

Zusammenfassung: Ein Wirbel aus der La-Meseta-Formation von Seymour Island wird mit Vorbehalt der seltenen Gattung *Xiphiorhynchus* (Teleostei, Perciformes, Xiphiorhynchidae) zugeordent. Er gehört zu einem der größten jemals beschriebenen Knochenfische.

Introduction

A diverse ichthyofauna occurs in the Eocene La Meseta Formation on Seymour Island (LONG, 1992; CIONE & REGUERO, 1994, 1998). While the elasmobranch fauna seems to be abundant and quite diverse, the diversity of teleost fishes appears to be low. However, this low diversity is probably due to taphonomic causes. The bulk of the fossil-bearing localities are in the middle and upper part of the sequence. Until now, the only vertebrates that were documented in the lower part of the La Meseta Formation were marine clupeoid teleost fishes (JERZMANSKA, 1992). In the Antarctic summer of 1993, DAVID H. ELLIOT while mapping the Sobral and "Wiman" formations

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collected a fragmentary teleost vertebra. Surprisingly, two years later, in the same place, MARCELO A. REGUERO and DAVID H. ELLIOT found another fragment belonging to the same specimen. Both are described here.

Locality and Stratigraphy

Seymour Island is one of a number of islands that lie south east of the northern tip of the Antarctic Peninsula (Fig. 1). Sedimentary rocks cropping out on the island form the uppermost exposed strata of a sequence that constitutes the infilling of the Early Cretaceous - Early Tertiary James Ross Basin (DEL VALLE et al., 1992; ELLIOT, 1988). The uppermost unit, the Lower Tertiary La Meseta Formation comprising an estimated 500-700 m of poorly lithified marine sediments, crops out in the northeastern part of the island. La Meseta Formation beds form the sedimentary fill of a 6 km wide channel.

On the basis of a reconnaissance study, ELLIOT & TRAUTMAN (1982) subdivided the formation into three informal members (Units I-III). Later, following two seasons of detailed mapping, SADLER (1988) identified and mapped seven major lithofacies (designated Telm 1-7). More recently MARENSSI (1995); MARENSSI & SANTILLANA, 1994; MARENSSI et al., 1998) have recognized unconformity-bounded units and proposed the establishment of an alloformation (La Meseta Alloformation) comprising six allomembers. The fossil-bearing locality lies close to the northeastern margin of the outcrops of the La Meseta Formation beds (Locality IAA 2/93; GPS data: 64° 13' 06" S, 56° 36' 36" W; 131 m above sea level). The site is about 30 m below the top of Unit I of ELLIOT & TRAUTMAN (1982) and at equivalent position below the top of the Acantilados Allomember of MARENSSI & SANTILLANA (1994). It lies about 70 m above the base of the continuous exposures of Telm 3, based on the geologic map by SADLER (1988).

Because the subdivisions proposed by SADLER (1988) are based on lithofacies rather than stratigraphy, we will use the nomenclature proposed by MARENSSI (1995; MARENSSI & SANTILLANA, 1994; MARENSSI et al., 1998). The Acantilados Allomember (the next to basal allomember) consists of interbedded muds and sandy muds with large scale synsedimentary slump features, cross-bedded muddy, very fine sands and lenticular channel fills with coquinas. Overall it is a coarsening-upward sequence. At the site of the vertebra find, the sediments are thin-bedded, clay-rich silty muds. The depositional setting of this allomember has been interpreted as a low energy, prograding delta front passing up into a subaqueous delta plain (MARENSSI et al., 1998), demonstrating a trend to shallower conditions. The presence of fossil wood and terrestrial vertebrates (VIZCAÍNO et al., 1994) and numerous

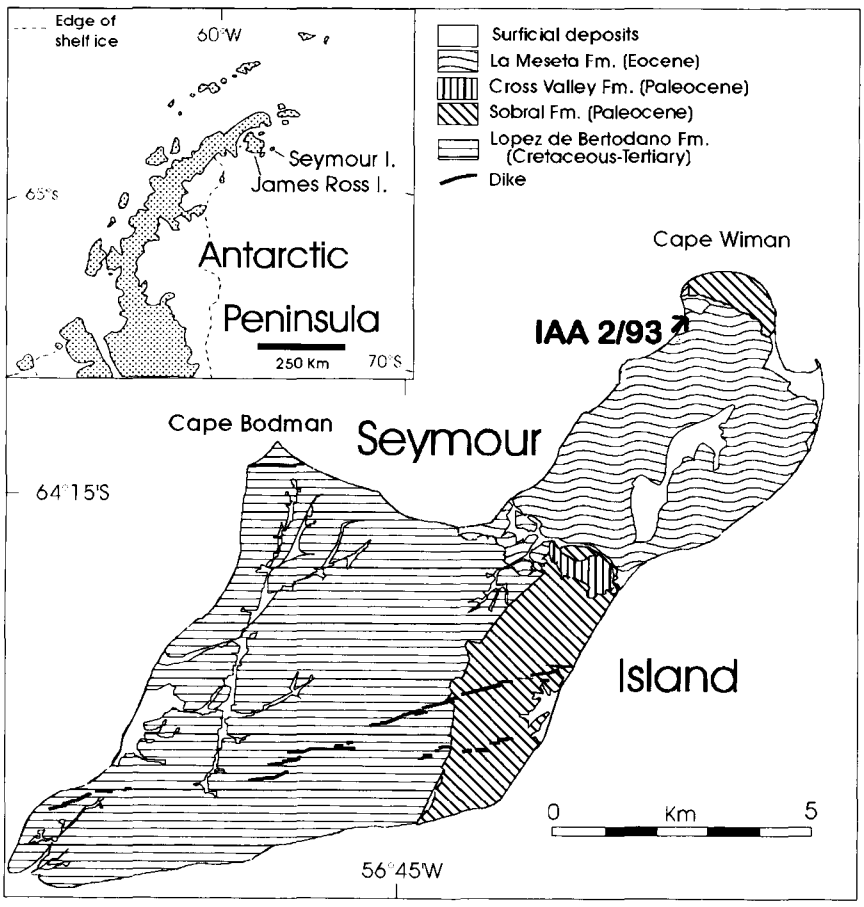

Fig. 1. Map of location.

shell beds (SADLER, 1988; STILWELL & ZINSMEISTER, 1992) suggest near-shore conditions for the overlying strata (Campamento Allomember; Unit II; upper part of Telm 3).

Microfossil data suggest a late Early Eocene age for the basal beds of the formation (Telm 1 and Valle de Focas Allomember; ASKIN 1993; COCOZZA

& CLARKE, 1992), and the uppermost beds are possibly earliest Oligocene (STILWELL & ZINSMEISTER, 1992). Dinocyst floras from beds assignable to the Acantilados Allomember are also regarded as late Early Eocene (WRENN & HART, 1988, fig. 11; sample 8502 was collected from approximately the same stratigraphic position as the vertebra). Neither the invertebrate macrofauna (STILWELL & ZINSMEISTER, 1992) nor the terrestrial palynomorphs (ASKIN, 1988) provide, as yet, a more precise age assignment.

The early Eocene is regarded as a time of maximun warmth in the Southern Ocean (KENNET & BARKER, 1990; STOTT et al., 1990). Oxygen isotope data suggest that from those peak conditions oceanic temperatures declined fairly steadily, culminating in the abrupt cooling close to the Eocene-Oligocene boundary (e.g. MILLER, 1992). This abrupt cooling, namely the terminal Eocene event, marks the onset of glacial conditions. The abundant and diverse invertebrate fauna in the lower part of the La Meseta Formation (Units I and II; the third and fourth allomembers; upper part of Telm 3 through to Telm 5) suggests warm conditions (STILWELL & ZINSMEISTER, 1992) as do the shark faunas (CASE, 1992). The terrestrial flora in the La Meseta beds, which is dominated by *Nothofagus* (ASKIN, 1992), together with the growth rings in fossil wood (BREA, 1998), indicate a temperate and seasonal climate throughout much of the La Meseta Formation deposition time. However, the fauna in the upper part of the formation includes fossil penguins and whales, as well as marked changes in the invertebrate fauna, md has been considered suggestive of cooler seas. Oxygen isotope results on invertebrate shell material from the formation (GAZDZICKI et al., 1992) are inconclusive. In summary, during the deposition of vertebra-bearing bed the seas in the vicinity of Seymour Island were probably warm and productive.

Systematic Paleontology

Teleostei

cf. Xiphiorhynchidae REGAN, 1909

cf. *Xiphiorhynchus* VAN BENEDEN, 1871 Figs. 2 a-d

Material: MLP 93-I-7-1, an almost complete caudal centrum. Telm 3 of La Meseta Formation, Seymour Island (Isla Marambio), Antarctica.

Description: The vertebra is very large and stout. The total length is 95 mm. The mesial faces are nearly circular (Fig. 2 a). The ratio of the height of the centrum measured at its posterior face (62 mm) to its length is about 0.65. Both the size and ratio compares with those of a caudal vertebra from

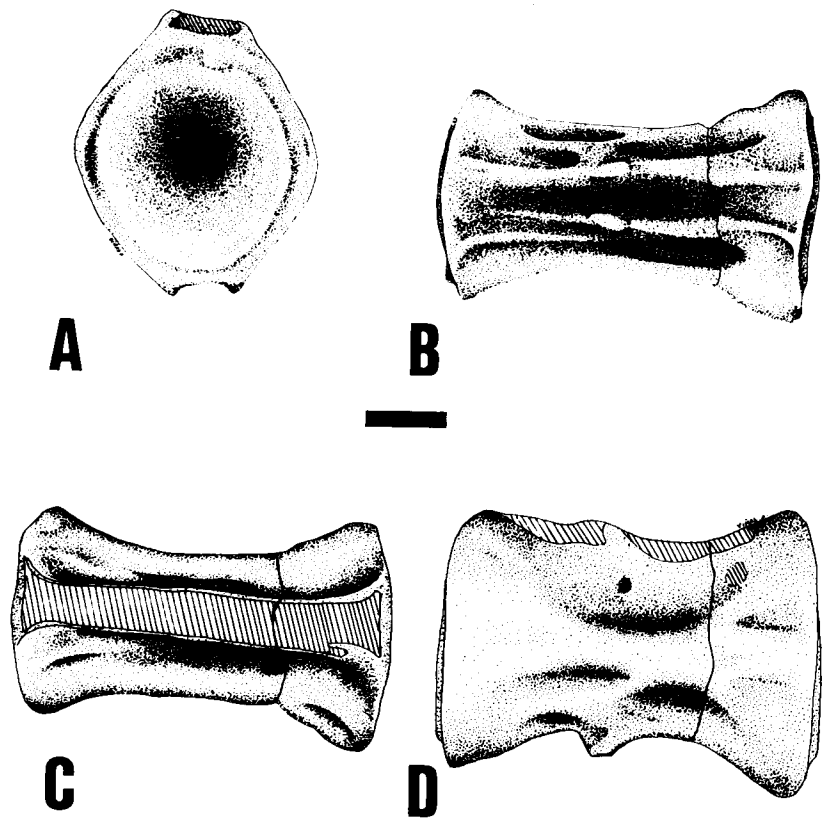

Fig. 2. cf. *Xiphiorhynchus*, vertebra, MLP 93-I-7-1. **A** - anterior view. **B** - ventral view. **C** - dorsal view. **D** - lateral view. The bar is 20 mm.

the Eocene of Mississippi (92.5 mm, 64 mm, 0.69; FIERSTINE & APPLEGATE, 1974; his Fig. 2),

The centrum is laterally constricted in the central area and shows an hourglass outline in ventral and dorsal views (Fig. 2 b, c). The ventral surface is concave in lateral view (Fig. 2 d). The zygaphophyses are broken off. The base of the neural canal is formed by two thin and parallel bone laminae. The neural and hemal spines are not preserved. The bases of hemal arches are

unexpanded as in the swordfish *Xiphias gladius* (GREGORY & CONRAD 1937). The surface is rugose. The dorsal and ventral fossae are huge. There is no median fossa.

Discussion: The only known teleost fishes of this size in the Paleogene are billfishes. Three nominal families of billfishes were recognized in the Eocene (see FIERSTINE, 1974, 1990): Palaeorhynchidae (Eocene-Oligocene), Blochiidae (including the "*Cylindracanthus* group"; Eocene), and Xiphiorhynchidae (Eocene-Oligocene). The association of these families as a monophyletic group, however, has been questioned (see FIERSTINE & APPLEGATE, 1974; JOHNSON, 1986). Based on the elongated upper and lower jaws, and numerous vertebrae, FIERSTINE (1990) has disputed assignment of the Palaeorhynchiids to the billfishes. Both Palaeorhynchidae and Blochiidae show long and slender vertebrae and usually were relatively small fishes (FIERSTINE, 1974, 1990). An exception is *Pseudotetrapturus luteus* from the Eocene of Russia which attained 4000 mm total length (DANIL'CHENCKO, 1960).

The extraordinary size and robustness, general shape, hour-glass shape in ventral view, proportions, and shape of the arch bases compares with the vertebral centra of the Eocene to Oligocene billfish family Xiphiorhynchidae (CASIER, 1966; FIERSTINE, 1974, 1990; FIERSTINE & APPLEGATE, 1974). The centrun although larger, closely resembles the vertebrae of Xiphiorhynchidae from the London Clay (CASIER, 1966: 316; his Plate 53, Fig. 2) but is especially similar to a vertebra of *X. kimblalocki* from the Eocene of Mississippi (FIERSTINE, 1974, his Fig. 3 C, D; FIERSTINE & APPLEGATE, 1974). Unfortunately, we did not succeed in finding a synapomorphy in the vertebra at generic, familiar or even ordinal level.

The monogeneric family Xiphiorhynchidae has been cited only in the Eocene of eastern North America (FIERSTINE & APPLEGATE, 1974), western Europe (CASIER, 1966; FIERSTINE, 1990), North Africa (WEILER; 1929 fide FIERSTINE, 1990), and the Oligocene of central Europe. Five species of *Xiphiorhynchus* have been recognized but were based fundamentally on characters of skulls or rostra.

DE MUIZON (1981) and DE MUIZON & DE VRIES (1985) mentioned, without descriptions or illustrations, a rostrum identified as cf. *Xiphiorhynchus* from the Pliocene of Sacaco (Perú). However, they referred the fossil to the family Xiphiidae. In consequence, the record is probably referable to a swordfish.

Previously xiphiorhynchiids were known only in the north Atlantic Ocean and western Tethys Sea (or its remnant, the Mediterranean Sea; FIERSTINE, 1990). Their possible presence in Antarctica agrees with the high temperatures suggested for the time of deposition of the bearing rocks (see above).

The present vertebra pertained to a large fish of perhaps about 350 cm total length comparing it with the Recent *Xiphias gladius* (see GREGORY & CONRAD, 1937). A 10.2 cm long abdominal vertebrae of *Makaira* was described for the Pliocene of Belgium (LERICHE, 1926), Presently, H. FIERSTINE (personal communication) is studying 13 cm long istiophorid vertebrae from the Pliocene of North Carolina. Large fossil bony fishes other than billfishes include the Jurassic *Leedsichthys problematicus* from Europe (possibly larger than 10 m; MARTILL, 1991), the Cretaceous North American acipenceriids (APPLEGATE, 1970), the Cretaceous North American teleost *Xiphactinus* (up to 480 cm); and the Cretaceous South American coelacanth *Mawsonia* (up to 400 cm; MAISEY, 1991).

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