AN OPLEGNATHID FISH FROM THE EOCENE OF ANTARCTICA

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ABSTRACT. The oldest remains of the teleost family Oplegnathidae are reported from Antarctica. Fragmentary beaks with the typical coalesced teeth have been discovered. The Antarctic material presents characteristic features of members of the extant Oplegnathidae: jaws lacking lateral canines, distinctly crenulate cutting margins, teeth with narrow cutting edges that show evidence of a bipartite structure; there are also large rounded molariform teeth on the medial face of the jaws. This record confirms that the seawater was temperate when rocks of Telms 4–5 (middle Eocene) of La Meseta Formation were deposited. Oplegnathids had at that time a wider geographical distribution than today.

NUMEROUS remains of chondrichthyan and osteichthyan fishes have been recovered from the La Meseta Formation (dated as Eocene by Elliot and Trautman 1982) in the northern part of Seymour Island, Antarctica (e.g. Woodward 1908; Cione *et al.* 1976; Cione 1978; Tonni and Cione 1978; Cione and Reguero 1994, in press; Welton and Zinsmeister 1980; Grande and Eastman 1986; Doktor *et al.* 1988; Eastman and Grande 1991; Jerzmanzska 1991; Long 1991*a*, 1991*b*, 1992).

Researchers from the Departamento Científico Paleontología Vertebrados, Facultad de Ciencias Naturales y Museo, with the support of the Instituto Antártico Argentino, have been surveying the Cretaceous and Tertiary rocks of Seymour and other neighbouring islands each summer. During the summers of 1991–2 and 1992–3, the palaeontologist Marcelo Reguero found three jaw fragments in the middle beds of the La Meseta Formation. These fragments appeared to be of an osteichthyan fish with coalesced teeth.

Only a few osteichthyan families have been described with coalesced teeth, namely the Tetraodontidae, Diodontidae, Odacidae, Scaridae, Oplegnathidae, and the fossil Paleolabridae. In the present paper, the Antarctic material is described and its identity discussed in relation to these families. In addition, the biogeographical and palaeoclimatological implications of the find are considered.

LOCALITY AND STRATIGRAPHY

The material was collected from the Eocene of the La Meseta Formation (Elliot and Trautman 1982) in the northern part of Seymour (Marambio on Argentinian maps) Island (64° 14′ S, 56° 43′ W), Antarctica (Text-fig. 1). The La Meseta Formation rests on the Cross Valley Formation or on the Marambio Group (Rinaldi *et al.* 1978; Rinaldi 1982). It consists of 600 m of shallow marine, poorly consolidated sediments. Sadler (1988) subdivided this unit into seven informal lithostratigraphical subunits named Telm 1 to Telm 7. The material comes from the middle part of the formation (Telm 5; Text-fig. 2). Telm 5 comprises well sorted sands, interlaminated sand/mud channel fills, and shelly conglomerates. Selachian teeth are very abundant in Telms 4–5 but rare in Telms 6–7 (Cione *et al.* 1976; Tonni and Cione 1978; Sadler 1988). In contrast, osteichthyan remains are relatively common in Telm 7. In the sand/mud lithofacies of Telm 5, plant remains (Gandolfo *et al.* 1990) are abundant, together with land mammals and marine invertebrates (Zinsmeister 1984; Woodburne and Zinsmeister 1984; Reguero *et al.* 1993). Telms 4–5 were interpreted by Trautman (1976) and Elliot and Trautman (1982) as being deposited in a prograding delta and could represent the

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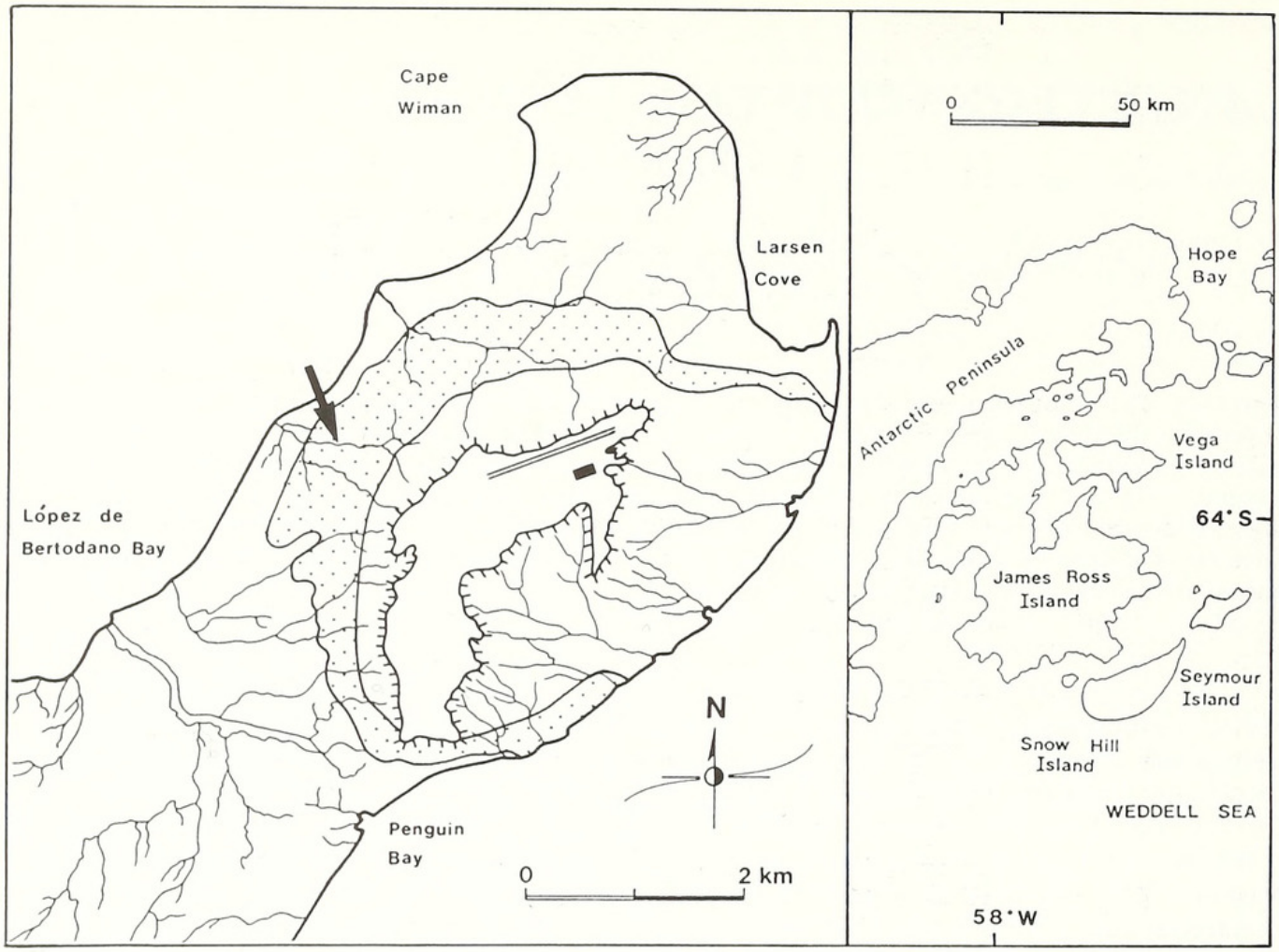


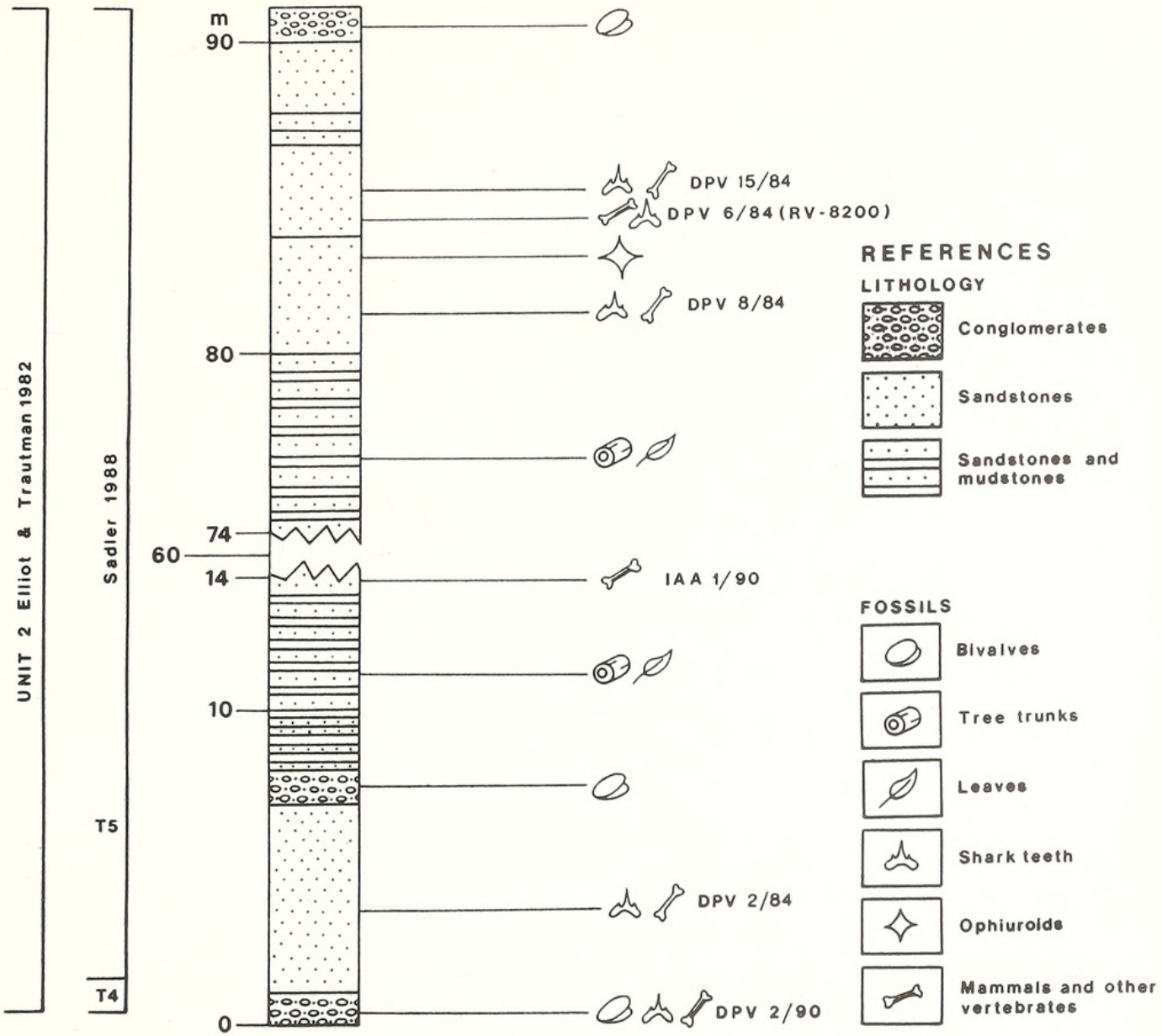
TEXT-FIG. 1. Sketch map to show the Seymour Island location and tip of the island with the outcrops of Telms 4 and 5 of the La Meseta Formation (stippled area). The arrow indicates the collecting locality IAA 1/90.

development of tidal channels and bars and/or spits with a sheltered back bar area. Dinoflagellate cyst, diatom, microplankton, and fish evidence suggest a middle to late Eocene age for Telms 4 and 5 (Wrenn and Hart 1988; Askin *et al.* 1991; Cocozza and Clarke 1992; Cione and Reguero 1994, in press). The mammal assemblage (closely related to South American taxa) indicate a middle Eocene age for Telm 5 (Mustersan in the southern South American standard; Reguero *et al.* 1993; Bond *et al.* 1993).

All material was collected from locality IAA 1/90 (Text-fig. 1) which is about 300 m north-west of locality DPV 6/84 (RV-8200 of Woodburne and Zinsmeister 1984 – the 'Rocket Site', or 'Mammal Site'). It is on an elevation of about 50 m overlooking the coast. This locality is also referred to by some authors as the 'Ungulate Site' because several South American ungulates were found there (Reguero *et al.* 1993; Bond *et al.* 1993; M. Reguero, personal communication). The macrofauna is dominated by naticid gastropods (*Polinices*), whilst bivalves, bryozoans, goneplacid crabs (*Chasmocarcinus seymourensis*), teredid bored wood, leaves, and several trace fossils have also been collected from this locality (M. Reguero, personal communication).

RECENT COMPARATIVE MATERIAL

Oplegnathidae: *Oplegnathus woodwardii* NMV A269; *Oplegnathus conwayi* NMV A712 (NMV – Museum of Victoria, Melbourne, Australia). *Oplegnathus insignis* (Museo Nacional de Historia Natural, Santiago, Chile). Scaridae and Odacidae – registration numbers of most material are given in Bellwood (in press). Odacidae: *Neoodax balteatus* MLP 9086; *Olisthops cyanomelas* MLP 9085.



TEXT-FIG. 2. Stratigraphical section (part of Telm 4 and Telm 5).

Scaridae: *Scarus sordidus* MLP 9087 (Museo de La Plata, La Plata). Additional unregistered material of the Tetraodontidae, Diodontidae, Scaridae, Odacidae, and Oplegnathidae were also examined.

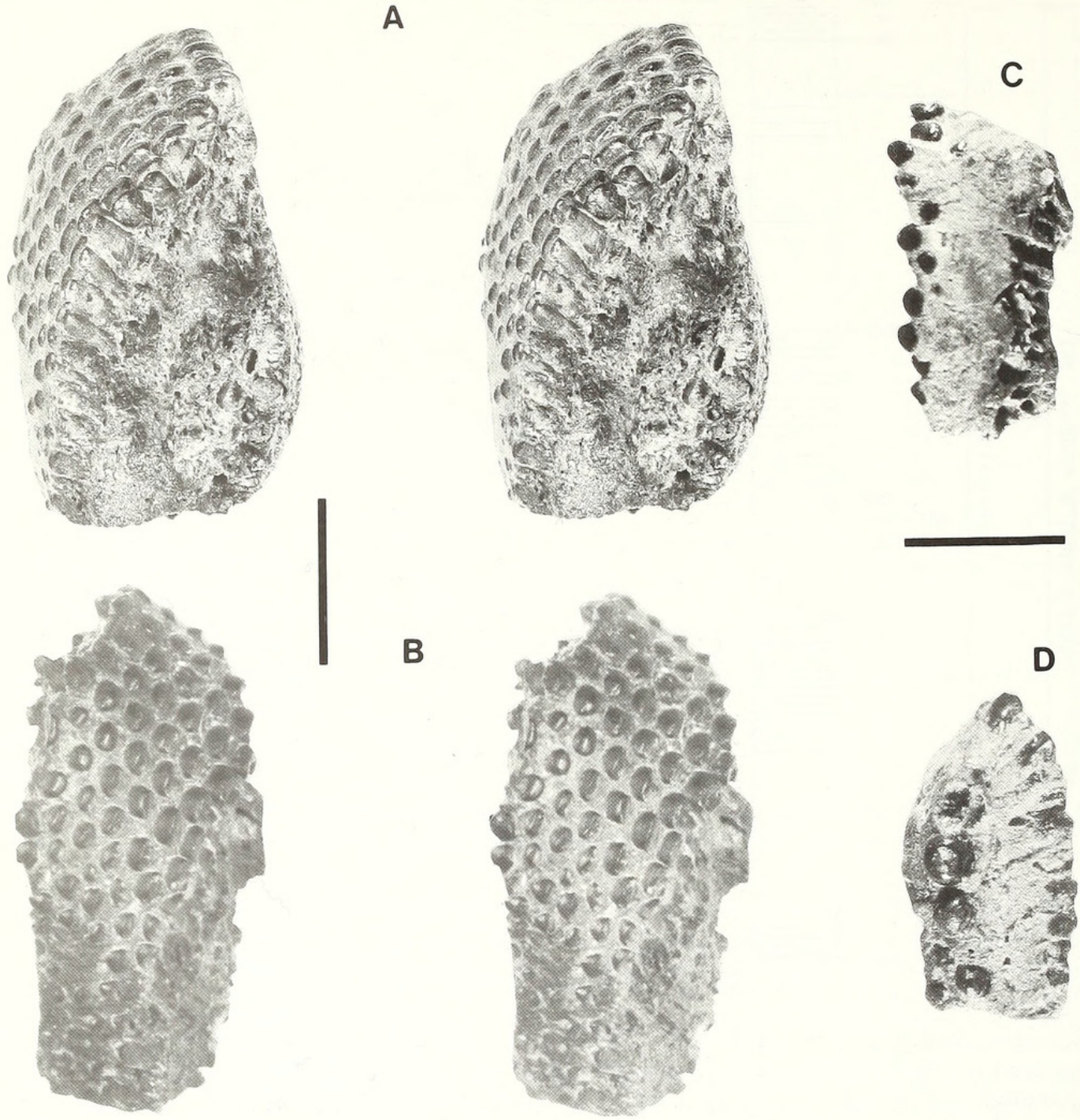
SYSTEMATIC DESCRIPTION

Order PERCIFORMES Muller, 1844
Family OPLEGNATHIDAE Bleeker, 1854
Oplegnathidae indet.
Form A

Text-figures 3A–B, 4

Material. MLP 93-1-6-5. Left premaxilla. All the Antarctic material is deposited in the Departamento Científico Paleontología Vertebrados, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina (MLP).

Description. The outer surface of the dental plate is nodular, with individual teeth exposed (Text-fig. 3A–B). The exposed face of each tooth consists of two different areas: basal and apical. The apical surface is covered by

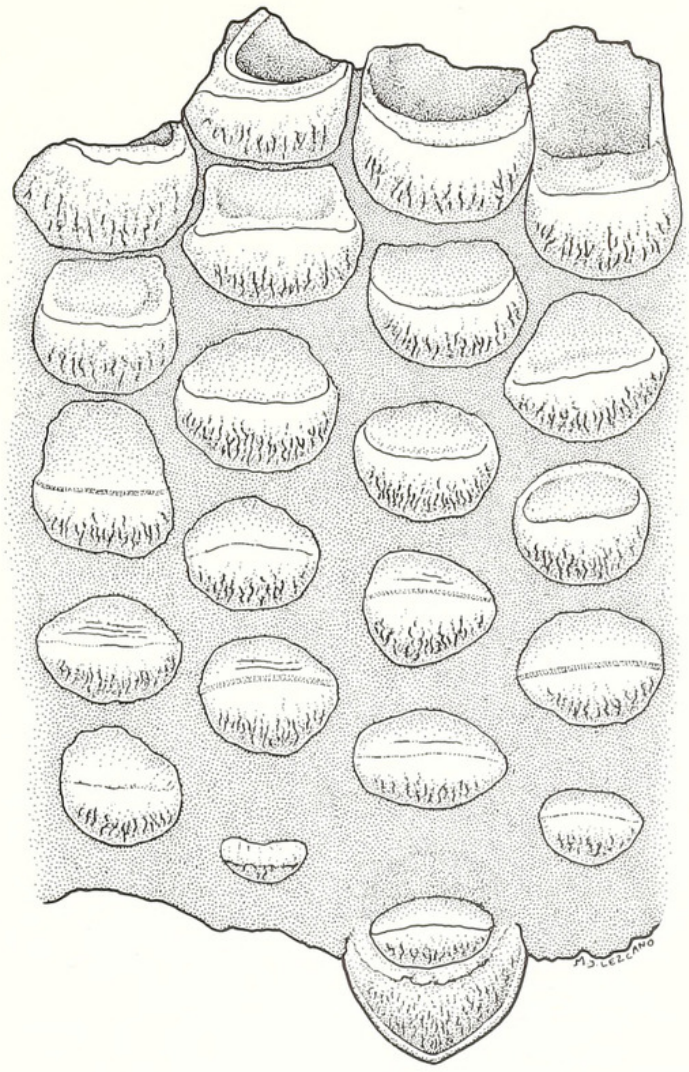


TEXT-FIG. 3. Oplegnathidae indet.; northern part of Seymour Island, Antarctica; Telm 5, La Meseta Formation (Eocene). A–B, Form A; MLP 93-1-6-5; left premaxilla; scale bar represents 10 mm. A, basal view. B, labial view. C–D, Form B; MLP 90-1-20-141; left premaxilla; scale bar represents 5 mm. C, labial view. D, occlusal view.

enameloid with a granular ornamentation. Both surfaces are clearly separated by a shallow sulcus (Text-fig. 4).

The occlusal surface of marginal teeth is rounded in teeth near the symphysis but that of more commisural ones is pointed. There are four complete incisiform teeth in the margin of the plate, while the remaining teeth are damaged. All marginal teeth present a transverse, sharp cutting edge. The basal boundary is rounded when complete (Text-fig. 4). Tooth rows are clearly recognizable and somewhat imbricate.

The outer series of teeth seems to be followed by a smaller inner series, near the symphysis; the symphysis is partially occupied by four strongly imbricated rectangular teeth. In addition, a few molariform teeth are



TEXT-FIG. 4. Oplegnathidae indet., Form A; MLP 93-1-6-5; northern part of Seymour Island, Antarctica; Telm 5, La Meseta Formation (Eocene); left premaxilla, detail of the labial surface.

located on the lingual side of the dental plate, below the cutting margin of the jaw. Canines are not visible. The symphysis is broad and plain.

Form B

Text-figure 3C–D

Material. MLP 90-1-20-141, jaw fragment. MLP 91-11-4-208, jaw fragment.

Description. MLP 90-1-20-141 is almost complete. The outer surface of the dental plate is smooth (Text-fig. 3C). Individual teeth (ten) are exposed only on the margin. Six teeth are completely erupted. The teeth are flattened, with a transverse cutting edge. The enamel is granular in appearance. A row of four large molariform teeth is located on the lingual face of the dental plate (Text-fig. 3D). These teeth are larger than the teeth in the dental plate. The second specimen (MLP 91-11-4-208) is fragmentary but is comparable to this form.

Although two forms are described, they may belong to different ontogenetic stages as the material appears to correspond to medium (Form B) and large (Form A) individuals.

ADDITIONAL FOSSIL MATERIAL OUTSIDE ANTARCTICA

There are a number of published records and additional undescribed fragments that bear a strong resemblance to the material described above. They are also provisionally referred to the Oplegnathidae (following Bellwood and Schultz 1991), although the fragmentary nature of the material means that any such designation must be tentative.

Chapman and Cudmore (1924) described the oplegnathid *Oplegnathus manni* from the Kalimnan formation (lower Miocene) of Victoria, Australia. *Scarus baltringensis* Probst, 1874 (also Wittich 1898), *Scarus priscus* Wittich, 1898, and *Scarus suevicus* Probst, 1874 are all based on dental plate fragments and all appear to be referrable to the Oplegnathidae (*cf.* Bellwood and Schultz 1991). All are from northern Europe, the two former '*Scarus*' species being recorded from Oligocene deposits (Wittich 1898).

Undescribed additional material. BMNH P38006 – Left premaxilla, Sharktooth Hill, Kern County, California, USA (Miocene); BMNH P13933, 13934, 9737 – dental plate fragments, Kalimnan, Beaumaris, Melbourne, Australia (Miocene) (BMNH – Natural History Museum, London, UK).

DISCUSSION

Systematic status

Of the six families reported with coalesced teeth, the material clearly differs from beaks of the families Odacidae, Tetraodontidae, Diodontidae, and the extinct Paleolabridae, by the presence of large rounded molariform teeth on the medial face of the jaws (see Boas 1879; Estes 1969; Britski *et al.* 1985; Gomon and Paxton 1985). In addition, in the tetraodontids and diodontids, the teeth are completely covered by an enameloid layer with no individual teeth erupting on the cutting edge, whilst the teeth of odacids are small, conical, and tightly imbricated (Gomon and Paxton 1985).

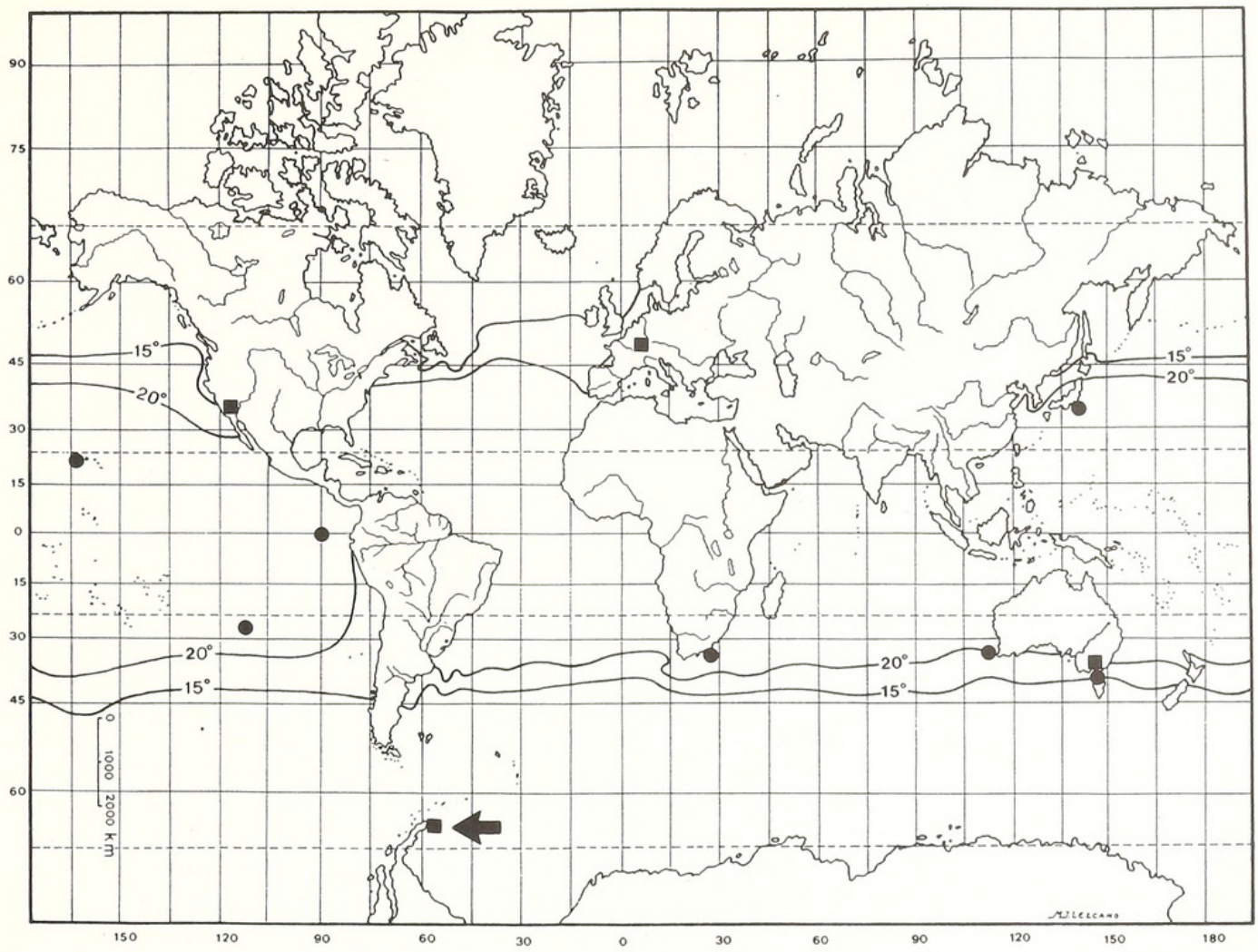
The two remaining families with coalesced teeth, the Scaridae and Oplegnathidae, both have representatives with molariform teeth on the medial face of the jaws (Bellwood and Schultz 1991; Bellwood, in press). However, the Antarctic material differs from extant scarids in several respects. The material may be distinguished from the genera *Cryptotomus*, *Nicholsina*, *Calotomus*, *Leptoscarus*, *Hipposcarus* and *Scarus* by the shape of the teeth and the absence of lateral canines (present in all but a few *Scarus* species). Of the extant scarids, the material most closely resembles the genera *Chlorurus*, *Bolbometopon*, *Cetoscarus* and *Sparisoma*, which share the crenate cutting edge and may lack lateral canines. Of these, however, only some *Sparisoma* species have molariform teeth on the medial face of the jaws. The material differs from *Sparisoma* and all other scarids in the form of the teeth with the distinct bipartite structure. In addition, the medial molariform teeth of *Sparisoma* are smaller than in the Antarctic material and most *Sparisoma* species have lateral canines.

In contrast, the form of the Antarctic material is entirely consistent with that of extant members of the Oplegnathidae. In the Oplegnathidae, the jaws lack lateral canines and have a distinctly crenate cutting margin, whilst the teeth have a narrow cutting edge and may show evidence of the bipartite structure; there are also large rounded molariform teeth on the medial face of the jaws.

At present, there are no dental synapomorphies available with which to positively identify a member of the Oplegnathidae, nor is the material sufficient to provide a robust identification. However, the features of the material available are, in all respects, comparable to those of Recent Oplegnathidae and the specimens are therefore provisionally placed in this family.

Biogeographical notes

This is the first record of an oplegnathid from Antarctica and the oldest known in the world. Its occurrence in the Antarctic Peninsula is not surprising considering their widespread present-day distribution in warm-temperate seas (Japan, western Australia, Tasmania, Hawaii, Easter and Galapagos islands, and South Africa; Text-fig. 5) and that temperate sea water was present off the Antarctic Peninsula when Telms 4–5 beds of the La Meseta Formation were deposited (Cione *et al.* 1976; Cione 1978; Tonni and Cione 1978; Cione and Reguero 1994, in press). This observation is



TEXT-FIG. 5. Distribution of the Family Oplegnathidae. The arrow indicates Seymour Island. Isotherms of 15 °C and 20 °C for February (southern Hemisphere) and August (northern Hemisphere) are depicted (according to Sverdrup *et al.* 1942). Squares represent fossil records and circles indicate recent reports.

further supported by the high frequency of occurrence of the sharks *Carcharias*, followed by *Squatina*, *Pristiophorus*, *Isurus*, and the skate *Myliobatis* (Cione *et al.* 1976; Cione 1978; Welton and Zinsmeister 1980; Long 1992). Recent representatives of these taxa are common in temperate seas (Cione 1978; Compagno 1984).

The age and locations of the fossil oplegnathids point to a widespread distribution during the early Cenozoic. This was followed by a contraction of the geographical range of the family, as evidenced by the absence of Recent representatives from both the Atlantic and Pacific coasts of North America. Both locations have fossil records of the family, with middle Miocene material from the west coast of North America pointing to a relatively recent loss of the family from this area. The timing of the loss from the Atlantic Ocean is unknown (except post-Oligocene in Europe). However, the extirpation of this family from the Antarctic Peninsula is probably associated with the drop of marine temperatures detected through the Telms 4–5 (middle Eocene) to Telms 6–7 (upper Eocene) in the La Meseta Formation (Cione 1978; Tonni and Cione 1978; for additional data on global climatic changes during the Eocene-Oligocene, see Frakes *et al.* 1992; Prothero and Berggren 1992). Why the family should be lost from the Atlantic, where warm-temperate waters could be found throughout the Cenozoic, is less clear. A similar reduction or extirpation from the Atlantic Ocean is known for the sharks *Heterodontus* and *Pristiophorus*. *Heterodontus* is common in Oligocene and Miocene beds in Patagonia and central Argentina (Ameghino 1906; Cione 1978). *Pristiophorus*

occurs in the Eocene to Pliocene of Europe, the Oligocene and Miocene of Patagonia, and also in the Eocene of Seymour Island (see Cione 1988; Cione and Expósito 1980; Grande and Eastman 1986). Only an endemic species, *Pristiophorus schroederi* Springer and Bullis, 1960 persists in the Bahamas region, western North Atlantic (Compagno 1984).

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