POLISH POLAR RESEARCH	13	3-4	241-253	1992

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Gadiform remains from the La Meseta Formation (Eocene) of Seymour Island, West Antarctica

ABSTRACT: Isolated and fragmented jaws, a single *basioccipitale* and *vertebrae* of the Gadiformes, indeterminate family and genus, are described from Eocene sediments of the La Meseta Formation, Seymour Island, Antarctic Peninsula. Based on the dentition and other characters of both jaws they are assigned an informal name of „*Mesetaichthys*". The remaining isolated bones belong probably to the same form.

K e y w o r d s : Antarctica, Seymour (Marambio) Island, Eocene, fossil fish, gadiforms, teleosts.

Introduction

In January 1992, during Argentine–Polish studies on Seymour (Marambio) Island, Polish geologists A. Gaździcki and A. Tatur found over 150 isolated teleost remains. According to Concheyro *et al. (in press)* the material comes from the uppermost part of the Eocene La Meseta Formation (Unit III of Elliot and Trautman 1982) *see also* Jerzmańska (1988, Fig. 1).

Only the best preserved cranial bones and centra of vertebrae of the Gadiformes are described below. The materials supplement previous reports on isolated teleost remains from the Paleogene of Seymour Island (Grande and Eastman 1986, Jerzmańska 1988, Long 1991). The only more completely preserved Teleostei in the La Meseta Formation are articulate skeletons of *Marambionella andreae* Jerzmańska of the family Clupeidae (Jerzmańska 1991), and a neurocranium of an indeterminate gadiform taxon (Eastman and Grande 1991).

The following specimens were used for comparisons: *Gadus morhua* L., *Theragra chalcogramma* (Pallas), *Melanogrammus aeglefinus* (L), *Micromesistius*

australis Norman, *Merluccius hubbsi* Marini, *Enchelyopus cimbrius* (L), *Muraenolepis microps* Lönnberg (collection of the Zoological Institute, University of Wrocław).

All specimens described here are housed in the Institute of Paleobiology, Polish Academy of Sciences, Warszawa (abbreviated as ZPAL).

Systematic paleontology

Subclass **Actinopterygii** (Cope, 1880)
Subdivision **Teleostei** (*sensu* Patterson and Rosen, 1977)
Superorder **Paracanthopterygii** (*sensu* Patterson and Rosen, 1989)
Order **Gadiformes** (*sensu* Cohen, 1984)
Family and genus indeterminate
(Figs 1 – 8)

M a t e r i a l . – Disarticulated and fragmented specimens (ranges of the length are given in mm): P.V/1–4, four premaxillae (24,9 – 36,8); P.V./5–16, twelve dentaries (22,9 – 94,9); P.V./17–23, seven anguloarticulars (22,4 – 44,6); P.V./24, one basioccipital (46,0); P.V./25–44, twenty vertebrae (measurements in Table 2).

Jaws

D e s c r i p t i o n . – Large, massive jaw bones with a weak ornamentation on outer and inner side. In the premaxilla a broad, hollow ascending process with numerous radial grooves on inner side, almost as high as the narrower and weaker ornamented articular process (Figs 1A,B,C). Tips of both these short processes are separated by a shallow, rounded incision. On ventral margin of the premaxilla, below the processes, two anterior, strong, closely spaced, canine–like teeth are preserved. The first tooth is almost as high as the ascending process, the other much smaller and shorter (Figs 1A,D). The structure of the teeth is similar to the structure of the large teeth of lower jaw described below. On one preserved fragment of the posterior part of the premaxilla, low, conical teeth (Figs 2A,B) are separated by wide pits after lost teeth.

The largest and best preserved dentary (Fig.3) slightly bent in its anterior part, terminated with a relatively broad symphysis. Two incisions dividing the posterior part of the dentary are situated asymmetrically in relation to each other. A well preserved anterior part of deep medial incision lies close to the ventral margin of the bone (Fig. 3B). On the outer side a poorer preserved anterior margin of lateral incision (Fig. 3A), situated much farther posterad, indicates that the incision was shallower than the medial incision. Along the outer surface of the dentary, closer to its lower, thin margin, there is a deep groove of the mandibular sensory canal (Fig. 3A). The distance between the

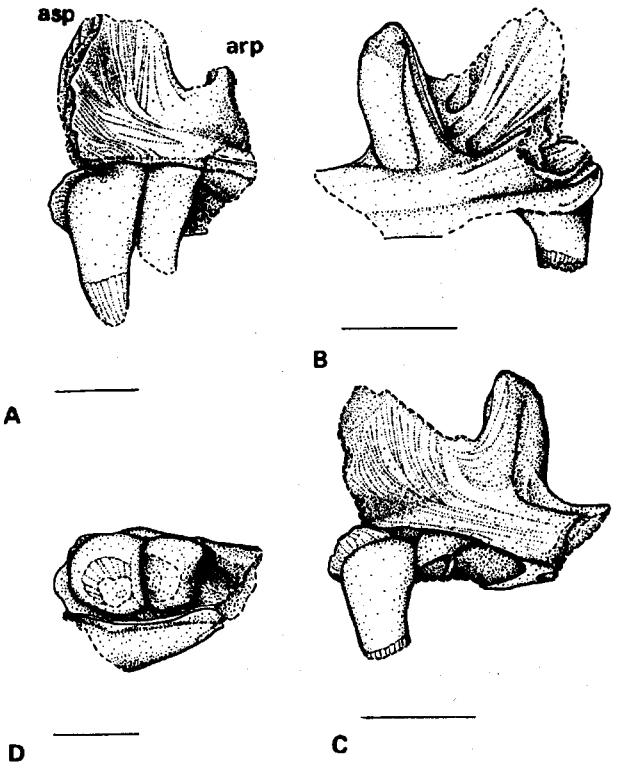

Fig. 1. Gadiformes, „*Mesetaichthys*". Anterior part of the left premaxilla: A – (P.V/1), C – (P.V/2), lateral view; B – (P.V/2), medial view; D – (P.V/1), ventral view. arp – articular process; asp – ascending process. Scale bars = 1 cm

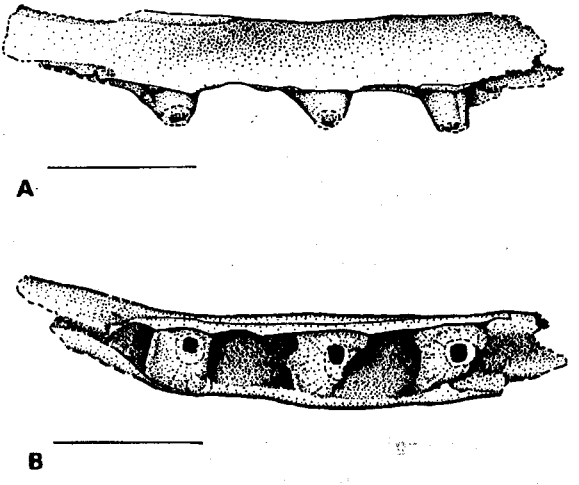

Fig. 2. Gadiformes, „*Mesetaichthys*". Middle part of the right premaxilla (P.V/4): A – medial view; B – ventral view. Scale bars = 1 cm

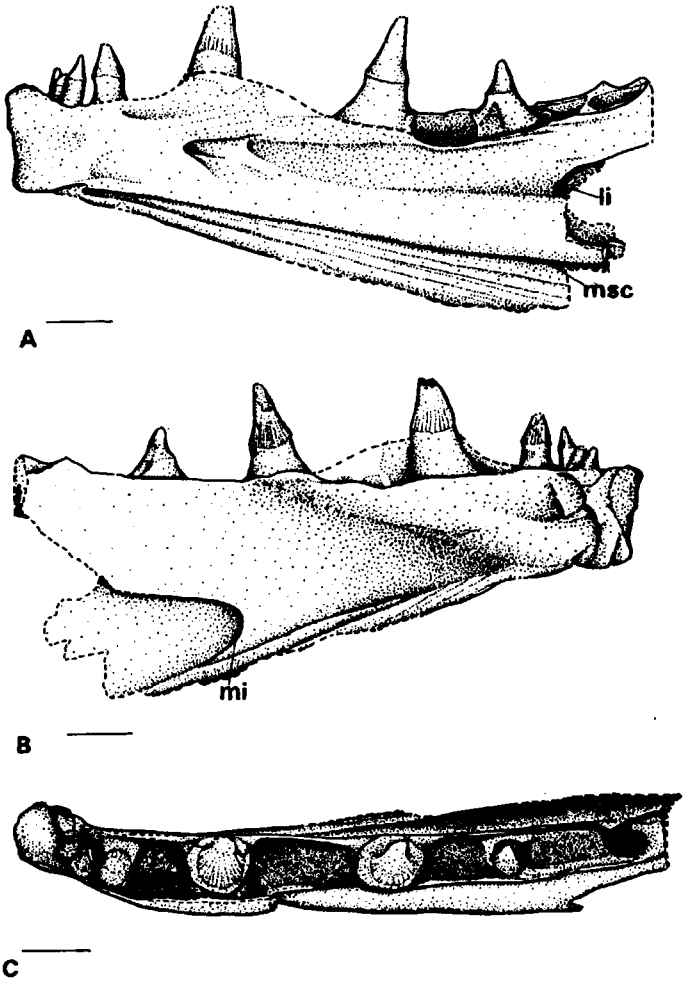

Fig. 3. Gadiformes, „*Mesetaichthys*". Left dentary (P.V/5): A – lateral view; B – medial view; C – dorsal view. li – lateral incision; mi – medial incision; msc – groove of the mandibular canal. Scale bars = 1 cm

groove and the ventral margin of the dentary increases considerably posterad, so that the lower margin of that bone lies obliquely relative to the groove. Above the groove a strong convexity is visible, widening posterad. Besides, a shallower and shorter depression is marked distinctly close to the dorsal margin of the dentary (Fig. 3A). The dorsal surface of the dentary has a shape of a gutter in which there is a single row of teeth of varied height and width (Figs 3A, C). Its internal margin is formed by a narrow, low ridge. The height of the external ridge varies, it is low near the symphysis, and the highest at the first or second canine–like tooth. The dorsal surface of the dentary tapers posterad to a bony ridge (Fig. 4). In the vicinity of symphysis there are 3 or 4 smaller, bent or straight pointed teeth, very closely spaced. Their bases are

mostly narrow, their cross–section oval. All the remaining functional, large and widely spaced canine–like teeth have their tips inclined inwards (Fig. 3A). The sizes of the teeth decreased gradually towards the posterior end of the dentary. The bases of the teeth are broad and have oval or roundish cross–section (Fig. 3C).

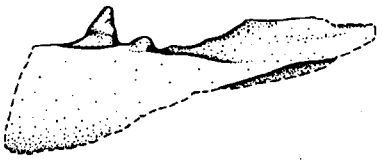

Fig. 4. Gadiformes, „*Mesetaichthys*". Posterior part of the dorsal limb of the right dentary (P.V/6) medial view. Scale bar = 1 cm

On the surface of the best preserved teeth in both jaws (premaxilla and dentary) numerous longitudinal grooves are visible, radiating from the tip to half or at least 1/3 height of the tooth (Fig. 3B). The dentition of the region of symphysis consists of small teeth of the dentary (Fig. 3A) and large teeth of the premaxilla (Fig. 1A), indicating that the upper jaw was produced relative to the lower.

On all the seven large, fragmentarily preserved anguloarticulars a massive, bluntly tipped postarticular process of angular bone is present (Fig. 5A). It is situated at an obtuse angle to the articular facet for the quadrate. On the outer side there is a fairly deep groove accomodating posterior section of mandibular sensory canal. The posterior part of the groove terminates at the base of the postarticular process (Fig. 5B). On the inner side, anterad to the articular facet, a distinct cavity is visible, situated between a thin bony plate and the external wall of anguloarticular (Figs 5A, C). A wide assymetrical articular facet for the quadrate reaches much lower on the medial side of that bone than on its outer side (Fig. 5).

The retroarticular is not preserved. However, the state of preservation and the structure of the posteroventral part of the anguloarticular preclude the participation of the retroarticular in the formation of the quadratomandibular joint. The state of preservation of the descending process evidences that it was long, and reached anterad far beyond the articular surface of the anguloarticular (Fig. 5). The coronoid process was strongly developed.

The long snout, large canine–like teeth and short ascending process in the premaxilla indicate that the jaws belonged to a predacious fish of food preferences close to those of *Merluccius* (Inada 1981), *Micromesistius* (Inada and Nakamura 1975) and Macrouridae with a less- or non-protrusible snout (Okamura 1970). The size of the bones described above indicates that they belonged to individuals of body length from about 90 cm to over 1,5 m.

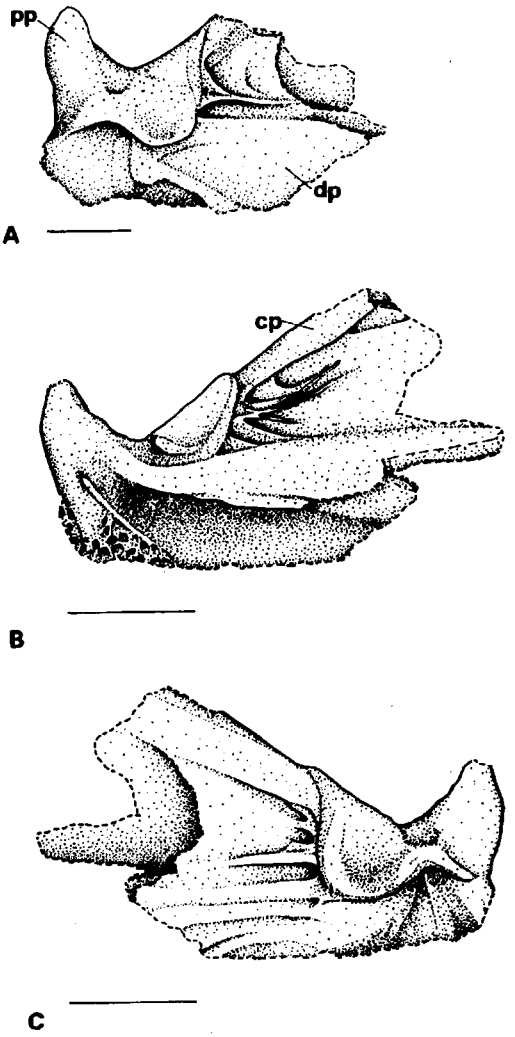

Fig. 5. Gadiformes, „*Mesetaichthys*". Anguloarticular: left (P.V/17), A – medial view; right (P.V/18), B – lateral view; C – medial view; cp – coronoid process; dp – descending process; pp – postarticular process. Scale bars = 1 cm

Comparison

Considering the occurence of the isolated remains described above in the same part of the lithological sequence of the La Meseta Formation, we are of opinion that the bones of both jaws represent the same genus. Below the remains will be termed „*Mesetaichthys*" (fish found in the La Meseta Formation). The name is used as a designation of convenience without a formal nomenclatural significance.

The position of „*Mesetaichthys*" within the Actinopterygii has been established based on the following characters which are preserved in the jaws examined:
Subdivision Teleostei: presence of postarticular process on the angular (Nelson 1973a).
Infradivision Euteleostei: articular co-ossified with the angular (Nelson 1973b, Lauder and Liem 1983); retroarticular is excluded from the quadratomandibular joint (Lauder and Liem 1983).
Superorder Paracanthopterygii: expansion of premaxillary ascending and articular processes (Lauder and Liem 1983); ascending process low and hollow (Rosen and Patterson 1969).

A closer affinity of „*Mesetaichthys*" with the orders Percopsiformes, Batrachoidiformes, Lophiiformes and Ophidiiformes is excluded because of the following characters of its jaw structure and dentition: In the premaxilla the ascending process is broader than the articular process, which stands in contradiction with the narrower ascending process in the Percopsiformes, according to Rosen and Patterson (1969); The ascending process is fused

Table 1

Comparision of jaw structure characters in „*Mesetaichthys*" and some gadiform species

Character of „*Mesetaichthys*"	*Merluccius*[1-3]	*Macruronus magellanicus*[4]	*Gadus morhua*[1]	*Theragra chalcogramma*[1]	*Melanogrammus aeglefinus*[1]	*Micromesistius australis*[1]	*Enchelyopus cimbrius*[1]	*Muraenolepis microps*[1]
Premaxilla: Ascending process wider than articular process	+	−	+	+	−	+	−	−
Shallow incision between ascending and articular processes	+	−	−	−	−	−	−	−
Dentary: Medial incision close to the lower margin of the bone	+	−	−	−	−	−	−	−
Medial incision deeper than lateral incision	+	−	−	−	−	−	−	+
Ventral margin of the bone oblique relative to the mandibular sensory canal	−	−	+	−	+	−	−	−
Anguloarticular: Long descending process	+	+	−	−	−	−	+	−
Presence of cavity on the medial side of the bone	+	−	−	−	−	−	−	−

References: [1]own unpublished data; [2]Inada (1981); [3]De la Hoz and Arenas (1976); [4]Howes (1991)
Symbols: +, present; −, absent.

with premaxilla, contrary to the ascending process with movable basal articulation in the Batrachoidiformes reported by Gosline (1970); The ascending and articular processes are not separated, as opposed to the separated ascending and articular processes in the Lophiiformes reported by Gosline (1973); The teeth are large, canine–like, few, widely separated, contrary to minute, densely arranged, granular and needle–like teeth in the Ophidiiformes according to Cohen and Nielson (1978).

The inclusion of „*Mesetaichthys*" in the Gadiformes was based on similarities in the jaw structure (Table 1), which are most similar to that found in *Merluccius* and somewhat less similar to that found in other members of the order. A unique character of „*Mesetaichthys*" is the presence of strong, large canine–like teeth in the region of symphysis on the premaxilla and in the mid part of the dentary. The lack of data on the structure of other bones of the skull renders it impossible to include „*Mesetaichthys*" to any known family of the Gadiformes.

Remarks

Among the fossil remains of the Teleostei from the La Meseta Formation there are fragments of illustrated but undescribed bones (Grande and Eastman 1986). The authors mention the incomplete premaxilla as „... resembling a gadiform type, but speciments are too incomplete to make a positive assignment; ..." and the fragments of lower jaw are referred to as „Indeterminate teleost partial dentaries ..." (Grande and Eastman 1986: 129).

A comparison of much numerous and better preserved jaws of „*Mesetaichthys*" with the photographs of Grande and Eastman (1986: Fig. 5a–i) reveals a similarity in the structure of the ascending and articular processes on the premaxilla, in the dentition of both jaws and in their ornamentation. On this basis we state that the isolated remains illustrated by Grande and Eastman (1986) belonged to small speciments of „*Mesetaichthys*". It can be also assumed, with a high probability, that the basioccipital and isolated centra described below, also belonged to „*Mesetaichthys*". However, only a find of articulated skeletons could fully confirm this conjecture.

Basioccipital

Description. – The measurements of the oval articular facet (Fig. 6A) of the only specimen (*in* mm) are: maximum height 21,0; maximum width 25,7. On the ventral part there are two fairly deep concavities for broad processes of the parasphenoid, reaching close to the margin of the articular facet (Fig. 6B). The bone belonged no doubt to a fish of body length exceeding 1 m.

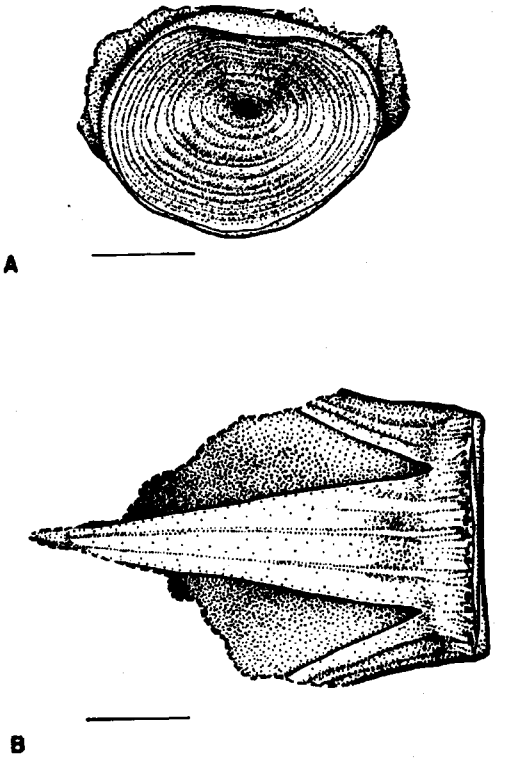

Fig. 6. Gadiformes. Basioccipital (P.V/24): A – posterior view; B – ventral view. Scale bars = 1 cm

Vertebrae

D e s c r i p t i o n . – All massive amphicoelic centra are shorter than high (Table 2), representing three regions of vertebral column according to Ford's (1937) division. Their structure agrees with that of the centra from the La Meseta Formation classified as gadiform (Jerzmańska 1988). The state of preservation of the centra found in 1992 allows some supplementing of the previous description.

The post–cranial section. – Six isolated centra, oval in cross–section, with no parapophyses. The first vertebra of this section is represented by four centra (P.V/25–28). All of them have a deep canal on the right and left side at the base of neural arch. The margins of the paired canal are traces of the right and left prezygapophyses which in extant Gadiformes unites the first cervical with the cranium (Rosen 1985). Triangular postzygapophyses directed posterad are visible on sides of the centra, like in the specimens described previously (Jerzmańska 1988, Figs 2–4). The centrum (P.V/29) has a deep pit

Table 2
Measurements (*in* mm) of gadiform vertebrae from the La Meseta Formation of Seymour Island

Vertebrae	Height	Width	Length
Post-cranial section	13.0 – 19.0	max. 15.6 – 24.4	9.5 – 11.6
Abdominal section	15.0 – 22.0	max. 16.6 – 22.0 min. 10.2 – 15.0	11.7 – 15.0
Anterior caudal section	15.4 – 18.6	max. 13.4 – 18.0 min. 8.3 – 13.0	10.5 – 14.4

on the right and left side below the bases of neural arch. The posterior margin of the pit, like in the third postcranial centrum in *Gadus morhua*, is formed by a broad postzygapophysis. Small postzygapophyses visible on the dorsal side of the centrum (P.V/30) indicate that it was one of the last post–cranial centra, resembling the fifth centrum in *Gadus morhua*.

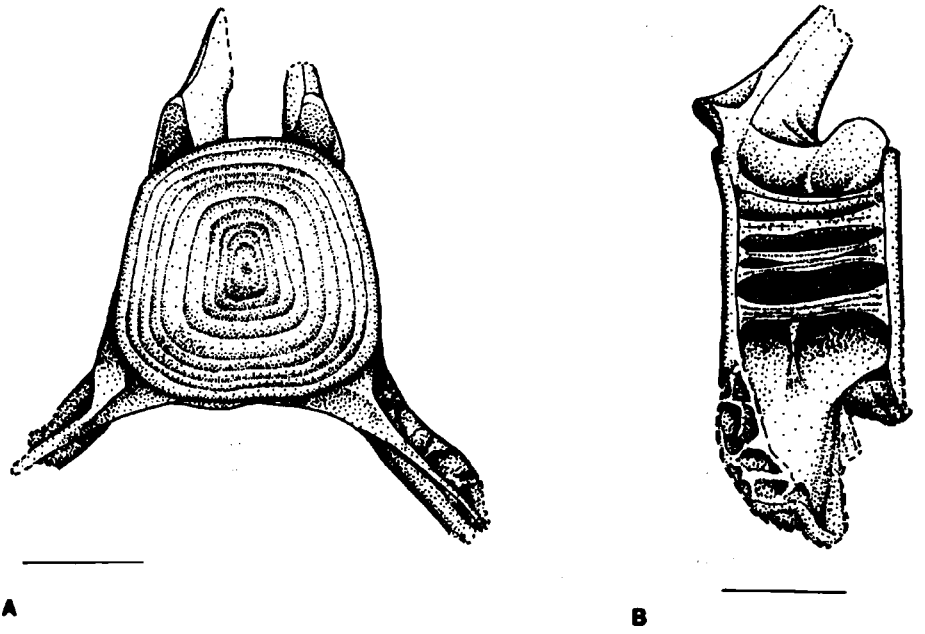

Fig. 7. Gadiformes. Abdominal vertebra (P.V/31): A – anterior view; B – lateral view. Scale bars = 1 cm

The abdominal section. – Six isolated centra of trapezial cross–section (Fig. 7A). On their dorsal side the following structures are preserved: broad bases of the neural arch; short prezygapophyses, broad and low postzygapophyses of rounded margins (Fig. 7B), of a size decreasing in centra of the posterior part of this section. On all the centra there are deep grooves along

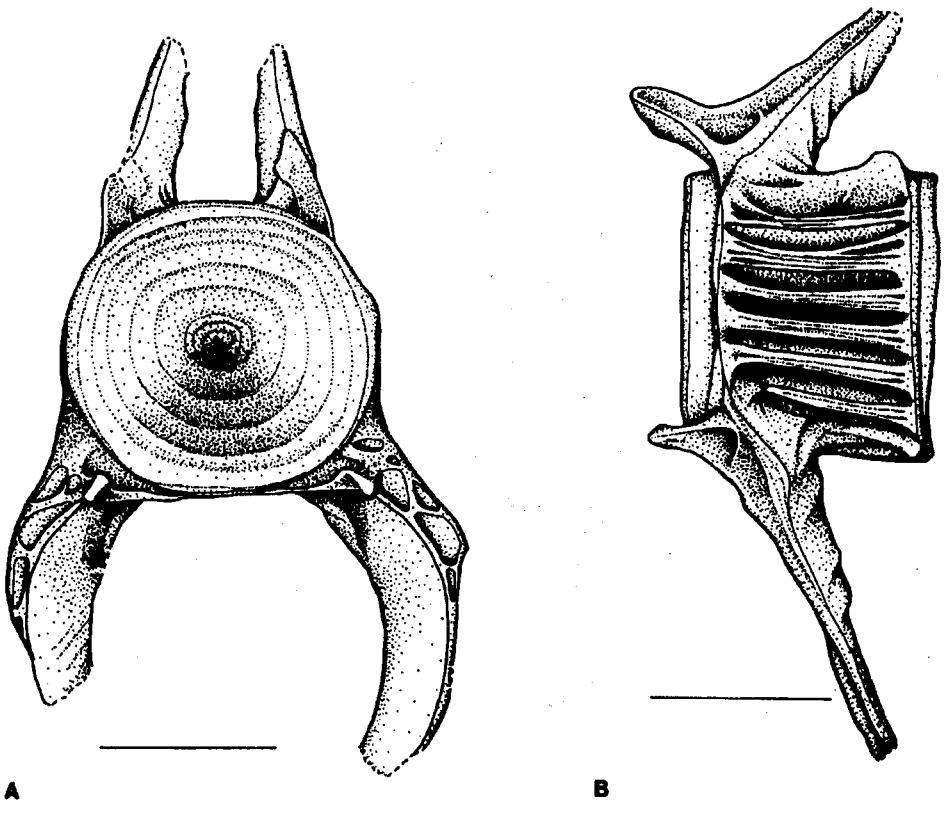

Fig. 8. Gadiformes. Anterior caudal vertebra (P.V/32): A — anterior view; B — lateral view. Scale bars = 1 cm

mid line. On the ventral side there are broad parapophyses (Fig. 7) and three deep grooves resembling those illustrated earlier (Jerzmańska 1988, Fig. 7); pre- and postzygapophyses are absent.

The anterior caudal section. — Eight isolated centra of nearly trapezial or rounded cross-section (Fig. 8A). On the dorsal side the following structures are preserved: bases of narrow neural arches; long, narrow prezygapophyses; small postzygapophyses preserved on one centrum only (Fig. 8B); a single deep groove along mid line. On the ventral side a considerable part of a bent haemal arch is preserved on one specimen only (Fig. 8A); on all the centra there are narrow, short postzygapophyses (Fig. 8B) and a single, narrow groove in the middle of the centrum.

Acknowledgements. — We are grateful to A. Gaździcki and A. Tatur for their permission to examine the materials collected by them, to Mrs E. Świdnicka M. Sc. for the drawings and to Dr. B.M. Pokryszko for translating the text into English.

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Received August 11, 1992
Revised and accepted August 24, 1992

Streszczenie

W styczniu 1992 roku podczas argentyńsko – polskich badań na Wyspie Seymour (Antarktyka Zachodnia) polscy geolodzy A. Gaździcki i A. Tatur znaleźli ponad 150 izolowanych szczątków ryb kościstych (Teleostei). Pochodzą one z eoceńskich osadów formacji La Meseta. Najlepiej zachowane kości czaszek i trzony kręgów (łącznie 44 okazy) reprezentują ryby dorszokształtne (Gadiformes) z nieokreślonej bliżej rodziny i rodzaju. Masywne szczęki reprezentowane przez *praemaxillare* (fig. 1–2), *dentale* (fig. 3–4) i *anguloarticulare* (fig. 5) zostały określone nieformalną nazwą „*Mesetaichthys*" (ryba znaleziona w osadach formacji La Meseta). Porównanie budowy szczęk „*Mesetaichthys*" i niektórych rodzajów współczesnych Gadiformes wykazuje największe podobieństwo tej formy do rodzaju *Merluccius* a w mniejszym stopniu do innych przedstawicieli tego rzędu (tab. 1). „*Mesetaichthys*" różni się od znanych dotychczas Gadiformes dużymi zębami w przedniej części *praemaxillare* i w środkowej części *dentale*. Brak danych o budowie innych kości czaszki uniemożliwia włączenie „*Mesetaichthys*" do żadnej znanej rodziny ryb dorszokształtnych. Z dużym prawdopodobieństwem można przyjąć, że izolowane *basioccipitale* (fig. 6) i trzony kręgów (fig. 7–8, tab. 2) należą również do „*Mesetaichthys*". Jednakże dopiero znalezienie całych szkieletów mogłoby potwierdzić to przypuszczenie.

Praca finansowana częściowo z programu KBN 1018/S/IZ/92.