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Endocranial cast of *Metaxytherium* (Mammalia: Sirenia) from the Miocene of Cerro Gordo, Almería, Spain

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RESUMEN

PILLERI, G. Molde endocraneal de *Metaxytherium* (Mammalia: Sirenia) del Mioceno de Cerro Gordo, Almería, España.

Durante el proceso de revisión de los Sirenia y Cetacea del Museo de Geología de Barcelona (MGB) se encontró, entre otros materiales, un molde endocraneal natural de vaca marina en buen estado de conservación. La casi totalidad del material español de Sirenia terciarios procede de Catalunya y ha sido discutido en una reciente monografía (PILLERI *et al.*, 1989). Después del descubrimiento de este molde endocraneal en la provincia de Almería se decidió describirlo en publicación aparte de la de los ejemplares catalanes.

Es bien sabido que la pronunciada lisencefalia de los Sirenia facilita la formación de moldes naturales fósiles de la cavidad craneal que reproducen la forma básica del cerebro.

Hasta 1933 sólo se conocían diez moldes craneales fósiles gracias a EDINGER. No se ha realizado ni una sola determinación del volumen del molde endocraneal de formas fósiles que permita una evaluación del grado de cefalización. Sólo se ha llevado a cabo para especies vivientes, incluida la vaca marina de Steller *Hydrodamalis gigas* (PILLERI, 1988).

Palabras clave: Mammalia, Sirenia, *Metaxytherium* sp., Mioceno Inferior de España, molde endocraneal, Paleoneurología comparativa.

ABSTRACT

A natural endocranial cast of *Metaxytherium* sp. from the Lower Miocene of Cerro Gordo, Almería, Spain, is described. The volume of the cast totals 500 cm^3, corresponding to the endocranial volume of the recent Dudong. In the same way as the volume, the shape of the Halitheriinae brain changes very little from the Miocene to the recent age. An exception is constituted by the endocranium of Stellers sea cow, *Hydrodamalis gigas,* which with 1.650 cm^3 exceeds all fossil and recent species. Among the cranial nerves, the nervus opticus and trigeminus have increased in size.

There are clear quantitative and qualitative differences between the Miocene and Eocene Halitheriinae. The latter display somewhat smaller, narrower brains and a more modest development of the frontal lobes. For the time being, calculations are available only for the cephalization of the recent species of Sirenia.

Key words: Mammalia, Sirenia, *Metaxytherium* sp., Lower Miocene of Spain, Endocranial Cast, Comparative Paleoneurology.

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INTRODUCTION

In the process of revising the Sirenia and Cetacea in the Geology Museum of Barcelona (MGB), I found among other material a well-preserved natural endocranial cast of a sea cow. Almost all the material belonging to the Spanish Tertiary Sirenia originates from Catalonia and has been discussed in a recent monograph (PILLERI *et al.*, 1989). After the discovery of this endocranial cast from the region of Almería, I decided to describe it in a separate paper, apart from the Catalan specimens.

It is well-known that the pronounced lissencephaly of Sirenia facilitates the fossil formation of natural moulages of the cranial cavity which reproduce the basic form of the brain.

Until 1933, altogether ten fossil cranial casts were known after EDINGER. Not a single endocranial cast volume determination has been made for a fossil form permitting an evaluation of the degree of cephalization. This has been done only for the living species, including Stellers sea cow *Hydrodamalis gigas* (PILLERI, 1988).

DESCRIPTION

Order:	SIRENIA ILLIGER, 1811
Suborder:	TRICHECHIFORMES HAY, 1923
Family:	DUGONGIDAE GRAY, 1821
Genus:	*Metaxytherium* DE CHRISTOL, 1840
Species:	*Metaxytherium* sp.

Locality: Cerro Gordo, Partaloa (Almería)
Age: Marine Miocene (Upper Burdigalian-Langhian)
Collection: MGB-No. 30.531, A. Cobos leg.

Both cerebral hemispheres are smooth. In dorsal view, they bulge slightly in the frontal and occipital region and are somewhat constricted in the region of the Sylvian fissure (= pseudosylvian depression).

The olfactory bulbs occupy a fronto-vertical position. There is a deeper furrow at the caudal end of the sagittal fissure in front of the cerebellum. The dorsal surface of the cerebellum (= visceral surface of the supraoccipital) is rather flattened; a shallow groove marks the boundary between the cerebrum and the cerebellum.

The lateral temporal region is almost completely covered on both sides by bone remains of the tympano-perioticum.

Among the brain base formations, the proximal sections of the tractus olfactorii, nervi optici and trigemini are recognizable. Between the two optical nerves we can distinguish the bulge of the basal surface of the flattened, roundish and large hypophysis. The region of the pons is overlaid by bone remains. There are two small oval depressions caudally in front of the margin of the foramen occipitale.

In caudal view, the visceral boundary between the supra and exoccipitale takes the shape of a perceptible crest forming a broad and dorsally open V with an angle of 120°.

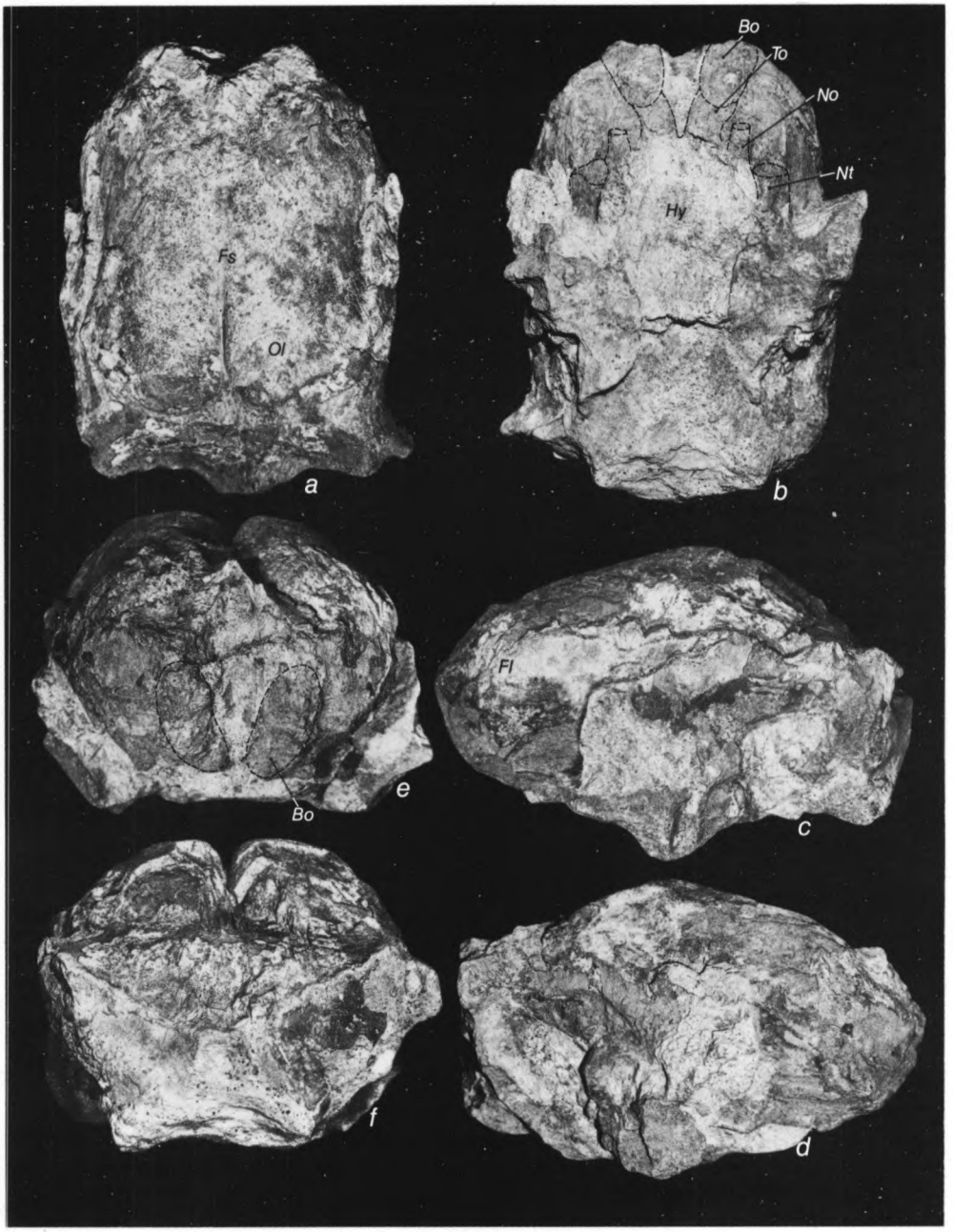

Plate 1
Metaxytherium sp., endocranial cast (MGB No. 30.531): *a* = dorsal view, *b* = ventral view, *c* = lateral left view, *d* = lateral right view, *e* = rostral view, *f* = caudal view. Bo = bulbus olfactorius, No = Nervus opticus, Nt = Nervus trigeminus, To = tractus olfactorius.

The endocranial cast volume is 500 ccm. The measurements are given in Table 1.

TABLE 1 - Measurements (mm)

	MGB 30.531	MGSB 25.700	Dugong Mus.Basel*
Total length	125	113	117
Width (frontal)	81	74	77
Width (occipital)	86	82	85
Fissura sagittalis, length	92	62-70	86
Length of hemisphere	103	93	94
Height of brain	70	(58)-70	72
Width between fissurae Sylvii	74	–	75
Bulbus olfactorius, vertical diameter	24	–	22
Bulbus olfactorius, horizontal diameter	12	–	12
Distance between the bulbi olfactorii	12	–	11
Tractus olfactorius, diameter	10(?)	–	12(?)
Tuberculum olfactorium, diameter	13	–	12
Nervus opticus, diameter	4.5	–	6.5
Distance between nervi optici	27	28	24
Nervus trigeminus, maximum diameter	12.5	–	17
Distance between nervi trigemini	40	–	38
Hypophysis cerebri, transverse diameter	25	–	–
Hypophysis cerebri, sagittal diameter	23	–	–
Height dorsal cerebellum pons base	52	–	50

* From skull No. 5.122 (cast in Coll. G. Pilleri)

DISCUSSION

A taxonomic identification at the species level is difficult. For more detailed comparison, a second endocranial cast of *Metaxytherium* sp. belonging to the same geological age from Santa Margarida i Els Monjos (Tarragona) is available. It is conserved under MGSB No. 25.700 at the Paleontology Museum of the Barcelona Seminary (PILLERI *et al.*, 1989).

The measurements differ in both specimens (Table 1). The present specimen is larger, particularly in the region of the cerebrum. The volume measured by means of a graduated cylinder amounts to 500 cm^3 in the present specimen compared with 305 cm^3 in the Catalan cast. However, it should be pointed out that the Catalan cast is of a juvenile sea cow with milk teeth.

Apart from the quantitative differences, the two specimens are very similar in shape (Fig. 1). Unfortunately, the Catalan cast lacks in addition to the olfactory bulbs the basal brain structures which would have permitted a more precise comparison.

Apart from the endocranial cast, only a few skull fragments, together with two last molars, were found of the Catalan specimen, so that no species definition can be made. It was possible merely to bracket known species, including *M. catalaunicum,*

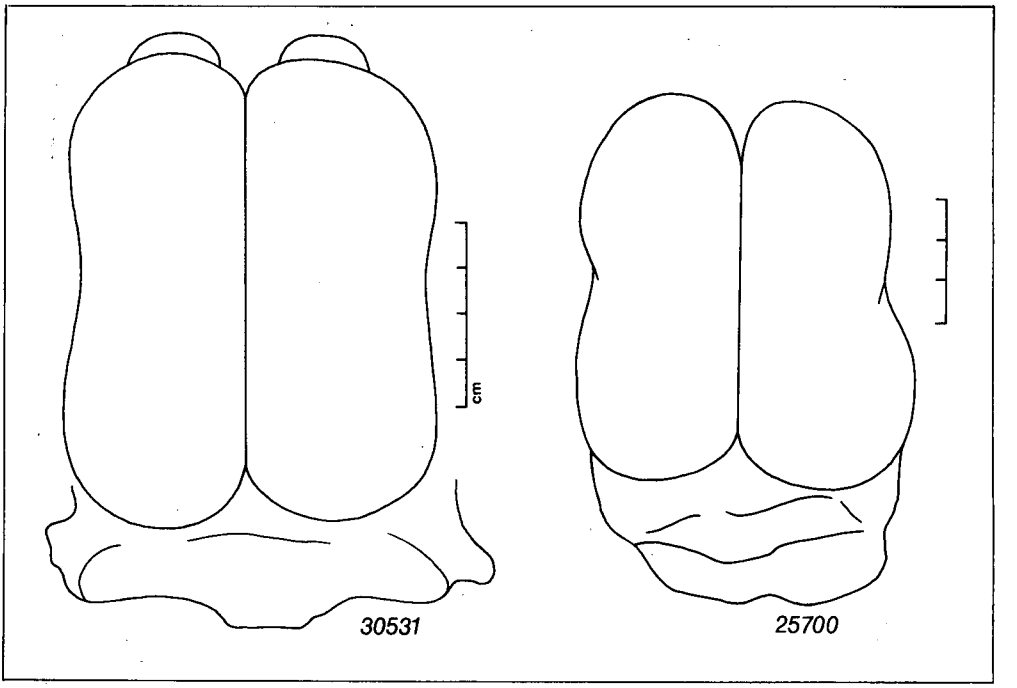

Fig. 1 - Diagrams of the endocranial cast of *Metaxytherium* sp., dorsal view: *a* = specimen from Cerro Gordo, *b* = from Santa Margarida i Els Monjos.

the only Spanish *Metaxytherium* which has so far been described in detail (PILLERI *et al., loc. cit.*). Unfortunately, the endocranium of this species is unknown.

As is pointed out above, the volume of the cast amounts to about 500 cm^3. I have measured the following endocranial volumes in recent Sirenia of different ages:

Trichechus inunguis	165 - 390 cm^3
Trichechus manatus	396 cm^3
Trichechus senegalensis	340 - 478 cm^3
Dugong dugon	390 - 455 cm^3
Hydrodamalis gigas	1.650 cm^3

It is therefore clear that the volume of the endocranial cavity of *Metaxytherium* remains roughly within the same range from the Lower Miocene to the present-day Dugong. In contrast, Stellers sea cow, *Hydrodamalis gigas,* attained the highest level of cephalization of all species, both fossil and recent.

So far as the endocranial volume is concerned, the Eocene and Oligocene forms are not substantially smaller than the Miocene ones, if we consider the cast measurements (see Table 2).

Unfortunately, however, in general terms, more precise conclusions cannot be reached concerning the cephalization of the fossil Sirenia, since we only know the body length of *Halitherium schinzi.*

In the same way as the total endocranial volume and the general shape of the brain have scarcely altered since the Miocene *Metaxytheria,* the individual sections of the endocast likewise display an extremely conservative pattern of evolution.

Table I contains the measurements of the individual parts of *Dugong dugon* (No. 5.122) from the Basel Museum collection. The point worth mentioning is that, although the other measurements remain very similar, the nervus opticus and nervus trigeminus, as well as their cranial canals, have increased in size in the recent species (4.5:6.5 mm; 12.5:17 mm), perhaps accompanied by a slight reduction in the olfactory bulbs.

A clearer change in the form of the brain occurs before the definitely conservative Miocene phase - in the Eocene. The Eocene species have endocrania which display a more modest development of the frontal lobes than is found in the Miocene form. The *Protosiren* and *Eotheroides* brain, which is narrower than that of *Metaxytherium,* displays anteriorly convergent lateral contours, which in *Metaxytherium* are more or less parallel, producing the box shape characteristic of the sirenian brain (see OWEN, 1875; EDINGER, 1933). Plate II illustrates some stages of the brain evolution in the phyletic line of the Halitheriinae from the Middle Eocene to the recent age. As an Oligocene genus, *Halitherium* occupies an intermediate position between the Eocene and the Miocene-recent forms.

TABLE 2 - Measurements of the endocranial casts (mm)

Species	*Protosiren fraasi* (ME)	*Eotheroides libycum* (MUE)	*Prototherium solei* (UE)	*Halitherium schinzi* (O)	*Metaxytherium* sp. (LM) MGSB 25.700	MGB 30.531	*Dugong dugon* (R)
Hirnlänge	94 - 102	95 - 100	85	82 - 108	113	125	115
Hirnbreite	60 - 75	60 - 75	60	65 - 67	82	86	86

ME = Middle Eocene
MUE = Middle, Upper eocene
UE = Upper Eocene
O = Oligocene
LM = Lower Miocene
R = Recent

ZUSAMMENFASSUNG

Ein Endocranialausguss von *Metaxytherium* sp. (Sirenia, Dugongidae) aus dem unteren Miozän von Cerro Gordo, Almería, Spanien wird beschrieben. Das Volumen der Moulage beträgt 500 cm^3 und entspricht dem endocranialen Volumen des rezenten Dugong. Wie das Volumen ändert sich auch die Form des Gehirnes der Halitheriinae vom Miozän bis zu den jüngeren Zeitaltern sehr wenig. Eine Ausnahme stellt das Endocranium der Stellerschen Seekuh, *Hydrodamalis gigas* dar, das mit 1.650 cm^3 alle fossilen und rezenten Arten übertrifft. Von den Hirnnerven nehmen opticus und trigeminus an Kaliber zu.

Deutliche quantitative und qualitative Unterschiede bestehen zwischen den miozänen und den eozänen Halitheriinae. Erstere weisen etwas kleinere, schlankere Gehirne und eine bescheidenere Entwicklung der Frontallappen auf. Über die Cephalisation der Sirenia liegen vorläufig nur für die rezenten Arten Berechnungen vor.

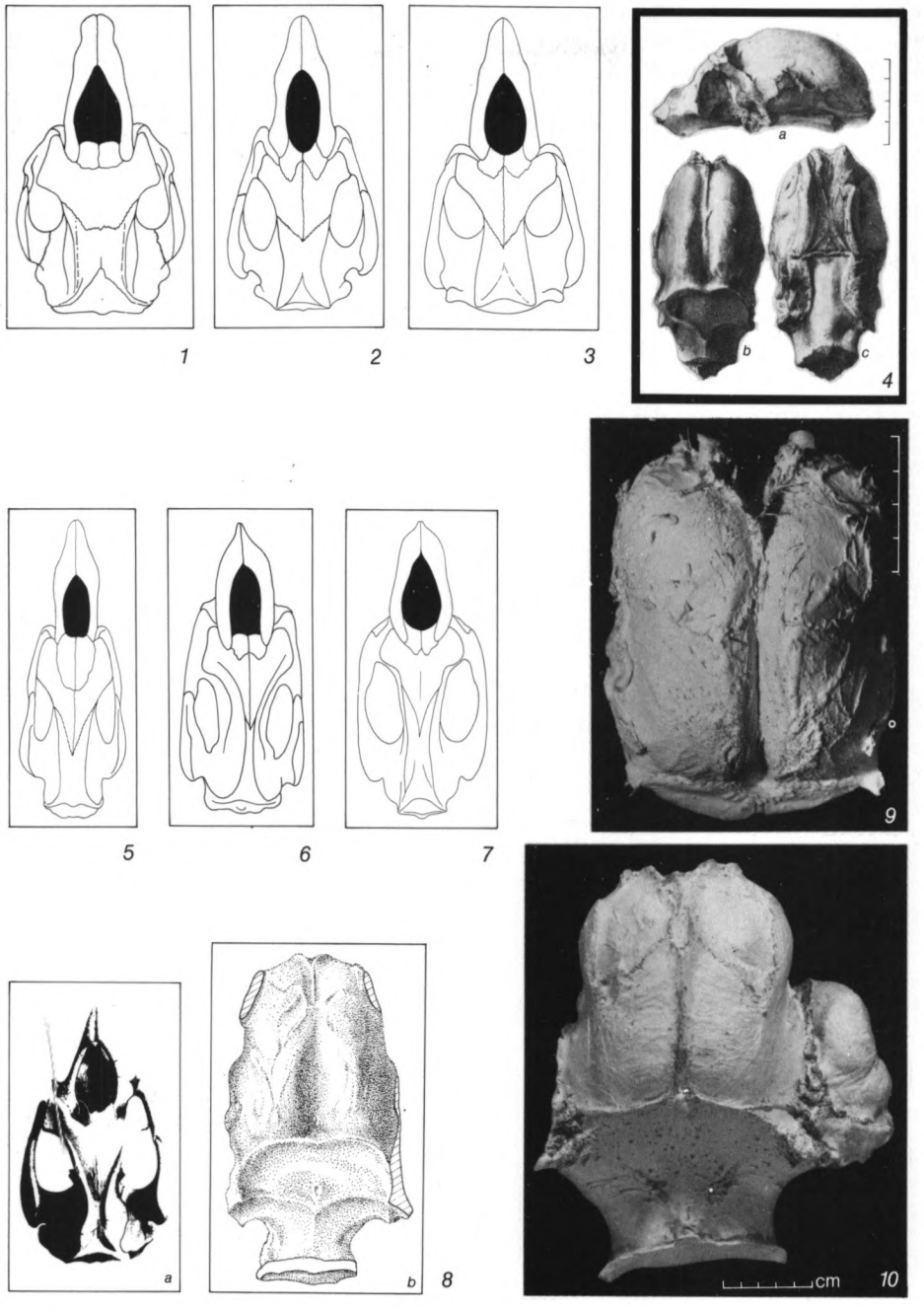

Plate 2
Skull and endocranial cast of Halitheriinae: *1= Protosiren fraasi, 2 = Eotheroides libycum* (acc. OWEN, 1875), *3 = Eotheroides stromeri, 4* = endocast of *Eotheroides libycum, 5 = Prototherium veronense, 6 = Prototherium intermedium, 7* = Prototherium solei, 8 = *Halitherium schinzi* (skull and endocast; acc. EDINGER; 1933), *9 = Metaxytherium* sp. (MGB 30.531), *10 = Hydrodamalis gigas* (Coll. G. Pilleri).

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