

**STATE OF FLORIDA
DEPARTMENT OF CONSERVATION
GEOLOGICAL SURVEY**

GEOLOGICAL BULLETIN No. 22

**CONTRIBUTIONS TO FLORIDA
VERTEBRATE PALEONTOLOGY**

**A FOSSIL SQUIRREL-FISH FROM
THE UPPER EOCENE OF FLORIDA**

By

G. Miles Conrad

**The American Museum of Natural History
New York, N. Y.**

**THE ROSTRUM OF
FELSINOTHERIUM OSSIVALENSE**

By

Joseph T. Gregory

**Bureau of Economic Geology
The University of Texas
Austin, Texas**

**Tallahassee, Florida
1941**

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**S. E. RICE, SUPERVISOR OF CONSERVATION
Herman Gunter, Director, Geological Survey**

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LETTER OF TRANSMITTAL

HONORABLE S. E. RICE
Supervisor of Conservation

SIR:

I have the honor to transmit a report entitled *Contributions to Florida Vertebrate Paleontology* for publication as Geological Bulletin 22.

This bulletin contains two papers, one by G. Miles Conrad of the American Museum of Natural History entitled, "A Fossil Squirrel-Fish From The Upper Eocene Of Florida," and one by Joseph T. Gregory of the Bureau of Economic Geology of Texas entitled, "The Rostrum Of *Felsinotherium Ossivalense*." These are valuable contributions to the vertebrate paleontology of the State and were generously contributed at no cost to the Geological Survey by the above mentioned institutions.

I want to take this opportunity of expressing my appreciation of the interest you have shown in the Geological Survey and the support you have given it.

Very respectfully,
HERMAN GUNTER, Director
Geological Survey.

Tallahassee, Florida
June 17, 1941

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THE UPPER EOCENE OF FLORIDA**

by

G. MILES CONRAD

AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK

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A FOSSIL SQUIRREL-FISH FROM THE UPPER EOCENE OF FLORIDA¹

by
G. MILES CONRAD

INTRODUCTION

Early in 1939 J. Clarence Simpson, Field and Museum Assistant, Florida Geological Survey, found a fossil fish in the Florida State Caverns situated two miles north of Marianna, in Jackson County, Florida. The block of Ocala limestone in which the fossil was embedded was carefully removed and forwarded by Herman Gunter, State Geologist of Florida, to the American Museum of Natural History in New York for study and preparation.

When finally worked out of its fine-grained limestone matrix the fossil proved to be almost complete and lacked only the anterior portion of the skull (Plates I and II). The vertebral column, which is almost complete, measures about 180 millimeters in length. From the basioccipital to the most anterior portion of the neurocranium which has been preserved the measurement is about 40 millimeters. In total length, from the tip of the snout to the most posterior part of the caudal fin the living fish probably measured about 270 millimeters, or 10½ inches. In greatest depth of body it is relatively shallow for a berycoid (of which group it is a member), for it is only about 70 millimeters, or 25% of the length. In general body-form it is indeed fusiform and carries little hint of the frequent berycoid tendency toward deep bodies (cf. *Hoplopteryx*, *Beryx*).

The occipital region is the best preserved of all the skull elements represented (Plates I and III, Figure A). In dorsal aspect the posterior half of the frontals, the parietals and the supraoccipital are present. The pterotic and sphenotic spines are much in evidence as are the posttemporals and a large, oval scale bone on the left side. Of the opercular series only a large fragment of the left operculum is present; the right operculum has been removed from the matrix, intact except for its spine (Plate III, Figure B and C). The primary upper jaw is represented by the hyomandibulars, the left metapterygoid, the right entopterygoid, and possibly the left pterygoid (or palatine). On the left lateral aspect is noted a portion of the maxilla and plastered upon it is the second

¹Manuscript received December 29, 1939.

suborbital. Noticeable in front view and from the sides are the alisphenoids, while on the right side the parasphenoid is in evidence.

In the preparation of the fossil the squamation has been left on the right flank (Plate II) while parts of the left side have been removed in order to expose the almost perfect vertebral column. Of the twenty-six vertebrae originally present, only two are completely absent.

For permission to describe this fossil I am indebted to Mr. Gunter and to Dr. William K. Gregory of the American Museum, to whom it was originally sent. I also wish to extend thanks to Mr. Edward Hawkins, Jr., who so carefully cleared the matrix from the specimen.

GENERIC AND SPECIFIC DETERMINATION

ACANTHOPTERYGII

BERYCOIDEA

Holocentridae

HOLOCENTRITES,¹ NEW GENUS

Genoholotype—*Holocentrites ovalis*, new species.

Distribution—Upper Eocene, Florida.

Diagnosis—Relatively fusiform holocentrid, the greatest body depth about one-fourth of the total length. A single heavy mesial ridge on each frontal bone, separated by a groove from a lateral series of smaller, less pronounced ridges. Robust, thickened supra-occipital crest; not produced posteriorly. Large, oval scale-bone. Vertebral formula: $11+14+1=26$. Parapophyses start on seventh vertebra; more delicate than those in *Holocentrus*. Anterior uro-neural united to twenty-sixth vertebra by suture only. Centra are shorter than they are deep. Scales pectinate and ridged.

Holocentrites ovalis,² new species.

Holotype—Florida Geological Survey, No. V-5453, Collected by J. Clarence Simpson, 1939.

Occurrence and type locality—Ocala limestone. Upper Eocene. Two miles north of Marianna, Jackson County, Florida at the Florida State Caverns.

Diagnosis—Sole known species of the genus.

¹*Holocentr-um*+*teris* like.

²*ovalis*, oval; in allusion to the large, oval scale-bone.

COMPARISON WITH *HOLOCENTRUS*

SKULL

Neurocranium—Comparison with a rather large series of acanthopterygians revealed that the fossil, *Holocentrites*, most nearly resembled berycoids of the family Holocentridae. Unfortunately, however, many of those osteological characters which define both the order Berycoidea and the family Holocentridae are missing from the fossil specimen. The distinctive feature of *Holocentrites* which led to its identification was the appearance of the fronto-occipital region. As seen from above (Plate III, Figure A) the frontals of *Holocentrites* and *Holocentrus* are prominently ridged and grooved. The mesially placed ridges are hypertrophied in *Holocentrites*, although they are rather prominent in *Holocentrus*. The frontals of the fossil shelve over the parietals and supraoccipital in such a manner as to leave a slight undercut. This "shelving" effect is typical of the holocentrids. Surmounting the pterotic spine is a scale bone. In *Holocentrites* it is large, oval and with serrated edges. A scale bone is present in *Holocentrus* and *Myripristis*, but it is proportionately smaller in both than in the fossil. The supraoccipital crest is similar in extent in both *Holocentrites* and *Holocentrus*, but it is considerably thicker and more robust in the former. In the extent of the supraoccipital both of these genera differ from the Cretaceous *Caproberyx* in which the crest extends almost as far posteriorly as does the operculum. In recent holocentrids when the skull is in the normal position the vertical plane of the occiput is more or less perpendicular to a line drawn from the tip of the snout to the pygidion, that is, the occiput does not extend behind the supraoccipital. Although the jaw remains have been crushed to the left, the fronto-occipital region of the fossil does not seem to have been much affected. In *Holocentrites* the occiput meets the "snout tip-pygidion" line at an angle of about 75 or 80 degrees.

The circumorbital series of *Holocentrites* is represented by only two fragments which are firmly plastered over the left maxilla. Their ventral edges are serrate as in most berycoids, recent and fossil, while the dorsal edge has been inflected to form, with the other suborbitals, a shelf. There is a slight overhang on the lateral dorsal side of this suborbital, presumably for the circumorbital canal. From the expanded size and disposition of these two fragments they may be defined as parts of the second suborbital.

Preserved in the fossil is the posterior portion of the parasphenoid with its ascending wings which contact the alisphenoids. As in other holocentrids the lateral flanges of the parasphenoid are quite wide. The basisphenoid has not been preserved in *Holocentrites*.

Branchiocranium—The operculum of the holocentrids is note-

worthy for its spiny character, but in *Holocentrites* the posterior edge of this bone has not been preserved. In the Holocentridae the anterior border of the operculum (Plate III, Figure B) has, running its entire length, a smooth band of bone about a quarter of an inch wide. Posterior to this smooth border the bone is marked by numerous horizontally-arranged striations. The mesial surface of the right operculum of the fossil (Plate III, Figure C) has been preserved and comparison with that of *Holocentrus* reveals interesting similarities. The socket which receives the hyomandibular process is Y-shaped in both. The lower arm provides a seat for the hyomandibular facet while the upper arm is braced more dorsally against the hyomandibular pedicle. In both a foramen tunnels under the leg of the Y. There are no striations on the mesial surface of the operculum of either *Holocentrites* or *Holocentrus*.

The preserved remnants of the primary upper jaw are quite fragmentary, but insofar as they may be compared they are not unlike their homologues in other holocentrids.

PECTORAL GIRDLE

The posttemporals of both sides are well preserved in the fossil. Posteriorly they are expanded into an oval-shaped plate with sharply serrated edges as in *Holocentrus* and *Myripristis*.

The remainder of the pectoral girdle which is preserved has much of the holocentrid character.

VERTEBRAL COLUMN

The vertebral formula of *Holocentrus* and *Myripristis*, according to Starks (1904), is: abdominals 11+ caudals 15+ hypural =27. However, Regan (1911) indicates that the Holocentridae have either 26 or 27 vertebrae. The specimen of *Holocentrus* with which *Holocentrites* was compared had 26 vertebrae. *Holocentrites* has a vertebral formula of 11+14+1=26, and thus it falls within the definition of the family. Although dissimilar in skull details the fossil resembles *Monocentrus japonicus* in vertebral count. According to Regan the Trachichthyidae have 26 vertebrae, but he makes no mention of their disposition into abdominals, caudals, etc.

The vertebral column (Plate I) satisfies Regan's general definition for the Berycomorphi in that it is composed of "solid centra which are co-ossified with the arches; anterior ribs sessile; posterior ribs on parapophyses; hypurals more or less fused and expanded;"

In *Holocentrus* a parapophysis is first present on the sixth vertebra, whereas in *Holocentrites* it appears first on the seventh. It is long, thin and pointed in the latter, but broad and squat in *Holocentrus*. It carries a pleural rib in *Holocentrus*, but this has apparently been lost in *Holocentrites*. In general the remaining para-

popphyses seem more robust in *Holocentrus*. The parapophyses are first connected to form a haemal arch on the ninth vertebra of *Holocentrus*, whereas on the fossil such a connection is first definitely preserved on the eleventh. In both forms, however, the parapophyses are completely fused at their tips to form a haemal spine on the thirteenth vertebra.

The posterior abdominals and the caudals are marked by two lateral fossae which seem to be more deeply incised in *Holocentriles* than in *Holocentrus*. The bar which separates these two pits is thicker in the former than in *Holocentrus*. In the *Holocentrus* skeleton with which this comparison was made the antero-posterior dimension of the centra was greater than the dorso-ventral, while the centra of *Holocentriles* seem to be shorter than they are deep. However, the figure of the *Holocentrus* skeleton given by Agassiz (1831) has vertebrae whose centra are proportionately much as those of *Holocentriles*. Such proportional differences are probably only of specific rank.

Spread throughout the matrix in the region of the abdominal vertebrae of *Holocentriles* were numerous epipleural ribs. Unfortunately all of them were very fragile and broke at the least touch, so that nothing was learned of their insertion. *Holocentrus* is well provided with epipleurals, some of which are attached to the centra and others to the pleural ribs. Pleural ribs are preserved on the third, fourth and fifth vertebrae of *Holocentriles*. In the lack of pleurals on the first and second vertebrae *Holocentriles* agrees with *Holocentrus* in which the first two vertebrae bear only epipleurals.

In *Holocentrus* the neural spine is expanded into a thin lamina near its proximal end which extends the length of the centrum. The neural spines of *Holocentriles* are much less laminate in the anterior abdominals and much more delicate in the posterior abdominals.

The anterior uroneural of the hypural complex in *Holocentrus* is fused to the last centrum, whereas in *Holocentriles* this element is united with the centrum by suture only. The tail segment (those vertebrae which enter into the support of the caudal fin) of both *Holocentriles* and *Holocentrus* apparently includes the last two vertebrae plus the hypural. The neural and haemal spines of *Holocentrus* are expanded on vertebrae 23, 24, and 25, but the spines of 23 stand free of the caudal fin rays. This is also the condition in *Holocentriles*, although the neural spine of the vertebra 23 is not preserved.

FINS

Except for a few isolated rays neither the dorsal nor the pectoral fins are present. The pelvic fins are thoracic in position and are represented by one spine each with fragments of a number of jointed rays.

Anal Fin—One of the family characters of the Holocentridae is the presence of four anal spines, of which series the third is the most prominent. *Holocentrites*, too, possesses four anal spines. Although the photograph (Plate II) shows only the second and third of the series, the others are present. These spines in *Holocentrus* are ornamented by very fine striations which anastomose much as do the friction ridges of the human finger-tips. In *Holocentrites*, however, the striations are very marked and do not anastomose, but retain their identity in an easy spiral around the body of the spine.

SCALES

According to Cockerell (1912) the scales of the Holocentridae "resemble in shape those of the Berycidae, being broad, with prominent laterobasal angles the apical margin is armed with strong, straight, comb-like teeth The basal margin is straight or nearly so, except that in the middle it is thrown into one or more folds or lobes, indicative of the rudiments of a basal radial system. The scales are broader than long"

In a very general way the scales of *Holocentrites* and other fossil genera fall into the family scale definition. However, their most obvious similarity among themselves and with the modern genera is in the condition of their apical margins which are always "armed with strong, straight, comb-like teeth." However, the basal margin in *Holocentrites* is more curved than straight and shows no evidence of the "rudiments of a basal radial system" noted by Cockerell among recent genera. *Hoplopteryx*, a berycid, shows these basal ridges, but *Homonotus*, assigned by Regan to the Holocentridae, seems to lack them. In all the fossil genera, including the Miocene *Muripristis melitensis*, the apical teeth are merely the free termini of strong longitudinally-placed ridges. This is also true of the recent species *Holocentrus ascensionis* and *Myripristis multiradiatus*, although the ridges are not as pronounced.

The scales of *Holocentrites* are considerably larger in absolute size than those of a *Holocentrus* of comparable dimensions.

PHYLOGENETIC SIGNIFICANCE OF HOLOCENTRITES

Throughout the Cretaceous of Europe and North America the Berycoidea were well represented by the Berycidae, such as *Hoplopteryx* and *Berycopsis*. Contemporary with this primitive family was a genus found in England, *Caproberux*, which Regan rightly places in the Holocentridae. In point of time, *Caproberux* can claim no greater primitiveness than other Cretaceous holocentrids, but in its skull structure it seems to be nearer to the bottom of the direct line leading to the modern genera than they are. Its occipito-frontal region resembles that of *Holocentrus* or *Muripristis*, more nearly than it does that of *Holocentrites*. However, it departs from all three of these latter genera in that its supraoccipital crest is

much extended posteriorly. The lack of a preopercular spine in *Caproberyx* suggests affinity to *Myripristis*.

Trachichthyoides ornatus, another Cretaceous berycomorph, seems to be referable to the Holocentridae. The mesial frontal ridges are strengthened as in *Holocentrites*, but they actually meet at their posterior ends. The lateral group of ridges fan out posteriorly in *Holocentrites*, but in *Trachichthyoides* they come to a point (Woodward, 1902, Plate VIII, Fig. 5 A). The operculum of the latter seems more expanded antero-posteriorly and there does not seem to be the same distinction between the striated and smooth portions as in *Holocentrites*, or the recent genera. The clavicle of *Trachichthyoides* seems also to be more expanded antero-posteriorly than in *Holocentrites*. In its emphasis of the mesial frontal ridges *Trachichthyoides* resembles *Holocentrites* more than it does either *Caproberyx* or *Holocentrus*.

Homonotus, an extremely small form from the Cretaceous of England, has been assigned to the Holocentridae. The material, as figured by Woodward, is rather imperfect and difficult to compare with *Holocentrites*. One salient feature of its anatomy is its lack of a preopercular spine.

Dinopteryx spinosus, provisionally assigned by Regan to the Holocentridae, is also notable for its lack of a preopercular spine.

This consistent lack of preopercular spine among the Cretaceous holocentrids seems to indicate that its presence is secondary. The implication being that *Holocentrus*, with one such spine, is more advanced phylogenetically than *Myripristis*. Unfortunately, however, *Holocentrites* lacks any indication of the condition of its preoperculum, so that no clue is here given to its phylogenetic place.

The North American Cretaceous representative of the Holocentridae is *Kansius*, from the Niobrara of Kansas. *Kansius* is a small *Holocentrus*-like fish. The enlarged anal spine is characterized by an "ornamentation of low, anastomosing, longitudinal wrinkling or ridging" (Hussakof, 1929). In this character *Kansius* resembles *Holocentrus* rather than *Holocentrites* in which the ridging is prominent and does not anastomose. In discussing the anal spines of *Kansius*, Hussakof wrote as follows:

"The greatly enlarged anal fin-spine calls for special comment. This character occurs in only a few families of teleosts, such as the Holocentridae (Squirrel-fishes), Haemulidae (Grunts), and the Lutianidae (Snappers). It seems to be best developed in the Holocentridae. It is remarkable that a seemingly unimportant character like this should persist for such a great length of time—from the Cretaceous up to the present day. It is even more remarkable that its ornamentation of very fine longitudinal wrinklins, which are hardly visible to the unaided eye, and for which we can conceive no

function of service to the fish, should likewise have persisted during this vast period of time, unaffected by evolutionary change."

It seems evident from these observations that *Holocentrites* early broke away from the main phylogenetic stem in this character and attempted a more novel anal spine. Fluting similar to that on the anal spines of *Holocentrites* is to be noted on the dorsal and pelvic spines of *Myripristis melitensis* as described by Bassani (1914).

Unfortunately the skulls of the two cotypes of *Kansius* are much fragmented and were not studied by Hussakof, so that its

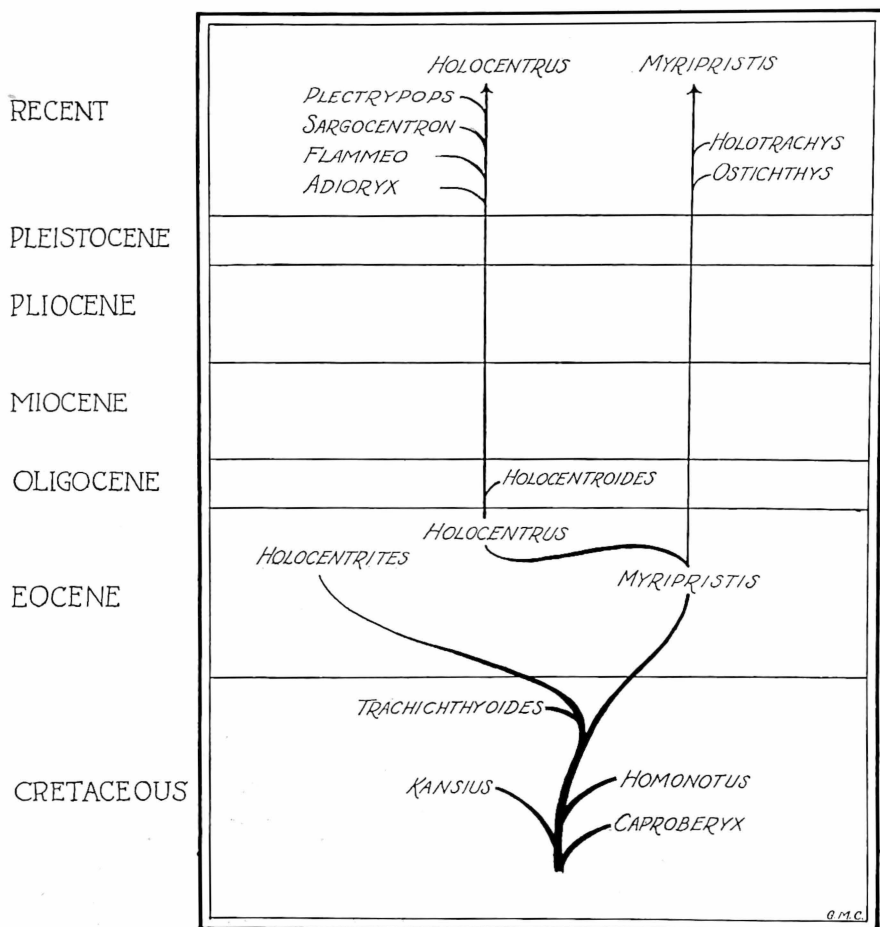


Figure I. A Phylogenetic History of the Holocentridae.

phylogenetic position is determined largely by fin counts and positions. It seems rather close to the main holocentrid stem, although the specific diagnosis of five, instead of four anal spines places it outside of the family as defined. Of the other Cretaceous forms, *Caproberyx* and *Homonotus* are definitely stated to have only four anal spines. Hussakof points out that in one cotype three spines are preserved and in the other there were four "with a strong probability that there were five, as in the existing *Holocentrus*." However, all species of *Holocentrus* seem to have only four such spines, so that a corrected definition of *Kansius sternbergi* might read: "Anal IV, and about 8."

By the upper Eocene the modern genera *Myripristis* and *Holocentrus* had become established in Europe. From the Oligocene of Rumania, Pauca has recently (1931) described a new berycid, *Holocentroides*, which may pertain to this family.

An analysis of comparable items in the various fossil genera seems to indicate that the Eocene *Holocentrites* and the Cretaceous *Trachichthyoides* are on an independent line of holocentrid development which has stressed anisomeristic development of the frontal ridges, while the main line leading toward the recent genera is characterized by a polyisomerism of the frontal ridges. At no stage, however, are any of the holocentrid genera very remote from each other, for the family is extremely compact and shows little adaptive radiation of body-form or essential anatomy. Nor is this devotion to a basic pattern confined to this particular family, for in writing of berycomorph scales, Cockerell says: "The Berycoidea . . . form a sufficiently compact group, quite isolated from the groups standing on either side of it in the system."

The recent "genera" of Holocentridae are in most cases merely sub-genera of either *Holocentrus* or *Myripristis*. The more primitive *Myripristis* has given rise to *Ostichthys* and *Holotrachys*. The first being characterized and distinguished from *Myripristis* by its rough scales. *Holotrachys* differs from both in its very much smaller scales; for example, whereas *Ostichthys* has 29 scales along the lateral line; *Holotrachys* has from 40 to 45. These have been treated by authors both as genera and sub-genera. The "sub-family" represented by this group seems to be characterized by its lack of a preopercular spine.

Holocentrus seems to have given rise to a number of recent "genera," or, more probably, sub-genera which are characterized in large part by the degree of spination of the preopercle. Among this group of holocentrids may be numbered *Flammeo*, *Sargocentrum*, *Plectrypops* and *Adioryx*.

Figure I, while hardly representative of an exhaustive study, suggests the phylogenetic history of the family Holocentridae.

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PLATES I-III

PLATE I

Left side view of *Holocentrites ovalis*, showing vertebral column and skull remains.

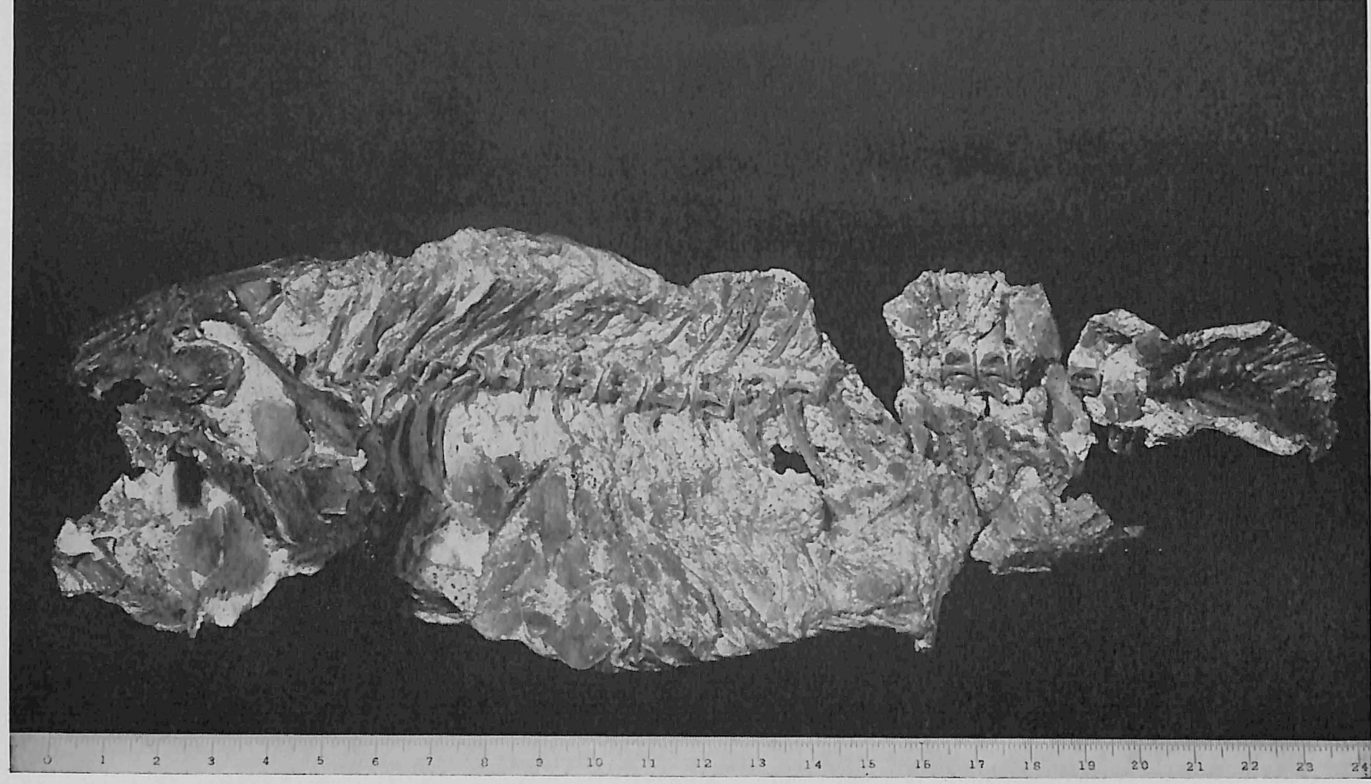


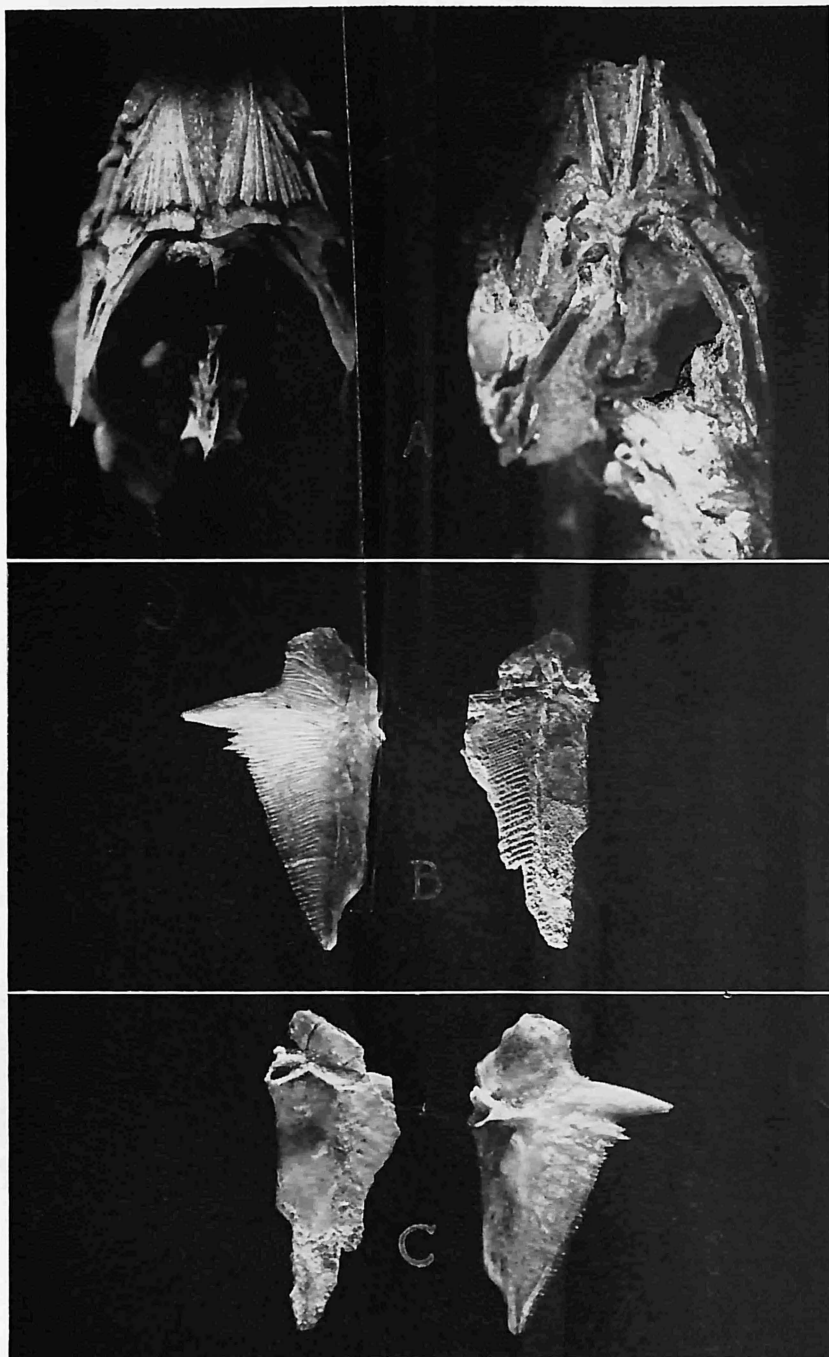


PLATE II

Right side view of *Holocentrites ovalis*, showing scales, anal fin spines and caudal fin rays.

PLATE III

A. Comparison of fronto-occipital regions of *Holocentrus ascensionis*, left; and *Holocentrites ovalis*, right. B. Outer view of the right opercula of *Holocentrus*, left; and *Holocentrites*, right. C. Inner view of the right opercula of *Holocentrites*, left; and *Holocentrus*, right.



**THE ROSTRUM OF
FELSINOTHERIUM OSSIVALENSE**

by

JOSEPH T. GREGORY

BUREAU OF ECONOMIC GEOLOGY

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FOREWORD

In July 1918, Mr. Anton Schneider, Superintendent of the Amalgamated Phosphate Company, submitted to the writer at Tallahassee, Florida, three photographs of the skull of a sirenian which he had obtained in connection with phosphate mining in the Bone Valley formation of Polk County, Florida. Following the receipt of photographs, Mr. Schneider was requested to send the skull for description, which he did. A few weeks later, the writer came to Texas, and in the ensuing years the skull, still undescribed, was lost sight of in the collections of the Bureau of Economic Geology of the University of Texas. Recently in overhauling the Bureau collections, the long lost specimen was found. In the meantime, Dr. G. G. Simpson (1932) described the fossil *Sirenia* of Florida. As it was not possible at that time to locate the skull, Simpson included in his memoir an illustration from photographs made by Schneider. Now that the skull has been found, the description already given from the photographs can be somewhat supplemented. Accordingly, at the writer's request, Dr. Joseph T. Gregory has described the skull as indicated in the accompanying manuscript. The skull is being returned to the Florida Geological Survey.

E. H. SELLARDS
Austin, Texas

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THE ROSTRUM OF *FELSINOTHERIUM OSSIVALENSE*¹

by
JOSEPH T. GREGORY

INTRODUCTION

In the collections of the Florida Geological Survey is a well preserved rostral portion of the skull of the little-known, extinct dugongid, *Felsinotherium ossivalense* Simpson. This specimen, number V-5454, lacks the downturned extremity of the premaxillaries and their included tusks, the posterior portion of the brain case, and the zygoma, but is otherwise complete and little crushed. It is of particular interest as it contains the most complete dentition of this Pliocene sirenian thus far found in America, and is the only known specimen of the anterior portion of the skull. Photographs of this skull were published by Dr. G. G. Simpson (1932, p. 452, figs. 12 A-C). Examination of the specimen itself reveals few features which he failed to observe on those illustrations.

Dr. Simpson has offered a number of valuable suggestions in connection with this study, and has most kindly read the manuscript. I am indebted to Dr. E. H. Sellards and to Mr. Herman Gunter for permission to study this specimen. Assistance in preparation of illustrations has been rendered by Dr. H. B. Stenzel and Mr. J. Wilson. This contribution has been made possible by co-operation between the University of Texas, Bureau of Economic Geology, and the Federal Work Projects Administration, Texas O. P. No. 665-66-3-233.

DENTITION

The tip of the rostrum is broken off opposite the end of the maxillary bone. No trace of roots of the tusks nor of alveoli for them occurs on the broken surface.

In addition to the two pairs of molars which Simpson described from photographs, the third molar of the left side is present, not yet fully erupted. In size and cusp arrangement it agrees fairly well with the type, though the proportions are somewhat closer to those of *F. floridanum*. The length is 1.37 times the width across the hypocone, much closer to 1.32, the proportion of *F. floridanum*, than to 1.77, the ratio in *F. ossivalense*.

A large protocone connects the protoloph with the anterior cingulum, which also connects at a lower level with the base of

¹Manuscript received May 2, 1940.

the paracone, leaving a lake in front of the protoconule. The paracone is slightly smaller than the protocone, and inclines inward

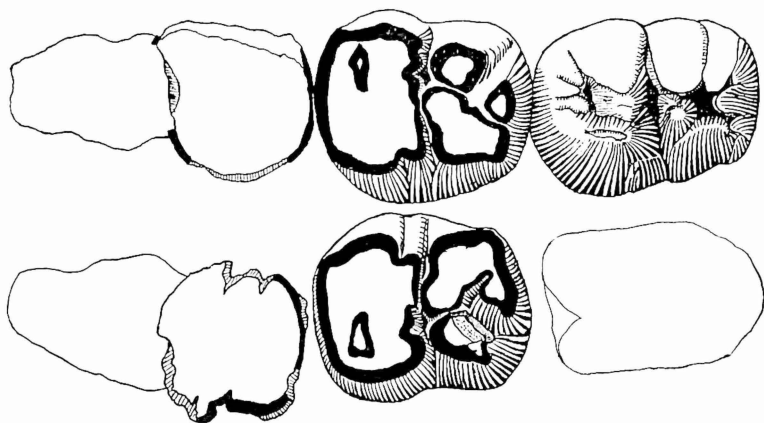


Figure 1. Upper molars of *Felsinotherium ossivalense* Simpson, occlusal view, x 1.

strongly from the outer margin of the tooth, so that it appears to squeeze the small protoconule against the protocone. A moderate sized metaconule lies nearly in front of the large hypocone, and, together with the posterior salient of the protocone, partially blocks the transverse median valley. The metacone is slightly forward relative to the hypocone, as in the type of *F. ossivalense*, and slopes inwardly even more than the paracone. One accessory cusp lies behind the metacone, a second at the middle of the rear of the tooth, lateral to the rear edge of the hypocone. A small postero-internal pillar is present as in *F. floridanum*. The minor differences in cusp arrangement and proportions between these various specimens suggest that these characters are of rather wide individual variation rather than specifically constant.

The two anterior molars have already been described by Simpson. On M² a small enamel lake remains to indicate the separation of protoloph and cingulum. There is a rather marked inflection of the enamel at the posterior inner edge of the protocone marking the position of a posterior salient which may have been more strongly developed than on M³. The worn hypocone and metaconule are joined, as may be seen from the figures. On the right side a slight evagination of the enamel at the postero-internal corner of the hypocone suggests an accessory pillar like that of M³; this is more faintly shown on the left side. A single hypoconule is present, with a ridge extending laterally from it to behind the metacone.

The only detail which may be observed on the greatly worn

first molars is a slight inflection of the lateral border, marking the position of the median valley.

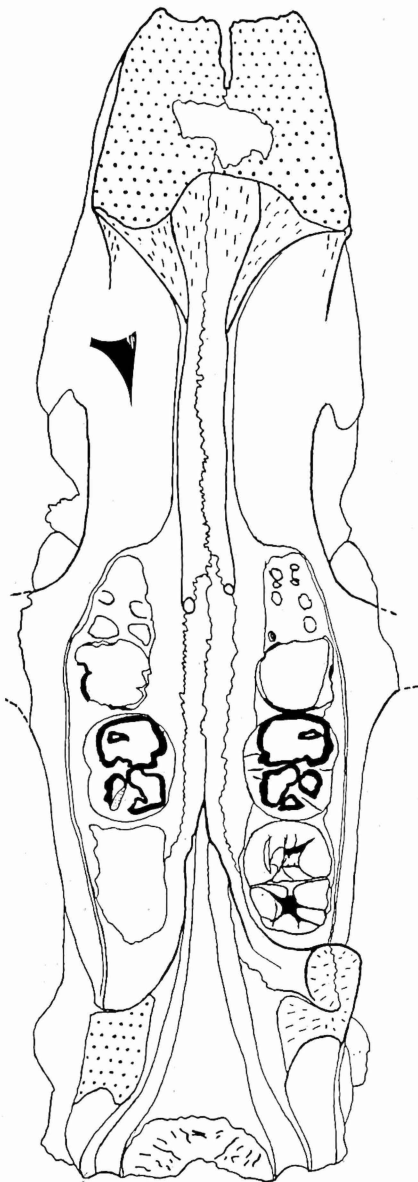


Figure. 2. Palatal aspect of anterior portion of skull of *Felsinotherium ossivalense*, x $\frac{1}{2}$

Anterior to the preserved teeth is an alveolar area $2\frac{1}{2}$ cm. long, narrower anteriorly than behind. Traces of the 4 root-sockets of Dp^4 and an indistinct smaller anterior region which lodged Dp^3 may be observed on the right side. Partial resorption of the alveolus suggests that the anterior of these teeth, at least, had been shed before the death of the animal. The amount of wear on M^1 prior to the eruption of M^3 is striking, whether Dp^3 and Dp^4 had been shed or not. The time of eruption of the last molar appears to be variable. The skull of *F. forestii* described by Capellini has M^3 in use and Dp^4 and Dp^3 still present, though worn. That of *F. serresi* described by Depéret and Roman has lost all trace of Dp^3 and has Dp^4 greatly worn but present. M^3 is moderately worn. Sickenberg (1931, p. 428) has emphasized the correlation between loss of tooth replacement with non-union of epiphyses and other neotenic characteristics which he attributes to a hypothyroid condition in the Sirenia. Possibly this retardation of growth also results in irregular time of tooth eruption.

Simpson (1932, p. 449) mentioned the possible alternative interpretation of the worn teeth in this skull as Dp^4 and M^1 . The amount of wear on the anterior tooth seems great for M^1 in an individual in which M^3 has not yet erupted, whereas one would expect Dp^4 to be worn before the posterior molars were implaced. According to this view the tooth described above as M^3 would be the second molar, and the third would still be contained in its crypt. However, the absence of any space in which a more posterior molar could form behind the last tooth present in the maxillary definitely indicates that this tooth is M^3 . On the right side of the skull the pterygoid process is broken away so that the short, solid end of the maxillary can be seen behind the alveolus of M^3 , leaving no doubt on this point. Moreover the anterior alveolar area is far too large for Dp^3 of *Felsinotherium*, and must also include space for Dp^4 . Lastly, the position of M^1 opposite the base of the zygomatic process is in accord with the conditions in other halitheriines, as pointed out by Simpson.

Depéret and Roman describe the molars of *F. forestii* as somewhat more complex than those of *F. serresi*. Those of *F. ossivalense* seem close to the latter species in this respect, though they differ in detail, and are considerably larger.

Measurements of dentition, left side.

	mm.	
Dp^3-M^3	102	
M^1-M^3	78	
Length M^1	20+	
Width M^1	22+	
Length M^2	28.0	Length M^3
Width M^2	26.2	Width heel M^3 1.37
Length M^3	30.1	
Width M^3 across protocone	24.2	Length M^3
Width M^3 across heel	22.0	Width M^3 1.24

SKULL

The premaxillary rostrum is broken off at the base of the expanded region of spongy bone at the distal end of the palatal surface. The maxillo-premaxillary suture passes from the lateral to the palatal surfaces at the base or ridges which bound the concave portion of the rostrum laterally. Behind this expanded region the rostrum is markedly elongate. For about 10 cm. anterior to the alveolus of Dp^3 , its palatal surface is subcylindrical, convex. Compared to *F. forestii* and *F. serresi* this region is much longer and more slender in *F. ossivalense*, approaching *Metaxytherium cuvieri* more closely in this respect though apparently even more elongate than in that species. In the European specimens of *Felsinotherium* strong ridges arise anterior to the cheek teeth, approach somewhat in this diastema region, and flare out again rather abruptly to join the base or the lateral ridges of the premaxillary rostrum. These ridges are scarcely distinguishable in *F. ossivalense*, in which they approach each other only slightly anterior to their origin at the alveolus for Dp^3 , and then extend forward, parallel, 15 mm. apart, bounding the median palatal grooves for about 75 mm. before turning outward to merge with the edges of the rostrum. So nearly as I can determine from published illustrations, this specimen is rather similar to *Metaxytherium cuvieri* in this respect, and it is certainly closer to it than to other *Felsinotherium* skulls.

The tendency toward elongation of the skull is reflected in the structure of the palate, which is exceedingly narrow. The width between the two first molars is 0.26 the length Dp^3-M^3 in *F. ossivalense* and 0.33 in a comparable specimen of *F. serresi*.¹ The tooth rows are less strongly arched than in either European species, and are most widely separated at M^1 instead of M^2 . This may be a character of immaturity, for the second palate figured by Depéret and Roman shows M^1 most widely separated. The narrow V-shaped inner narial notch reaches the rear of M^2 . In this it is intermediate between *F. serresi*, in which the notch reaches the anterior part of M^2 , and *F. forestii* in which it only reaches M^3 . The palatine bones send extremely narrow processes forward to the anterior palatine foramina between Dp^3 . Posteriorly the palatines extend backward along the sides of the narial notch and turn down to form the anterointernal portion of the heavy pterygoid processes. The main portion of these processes is fused with the alisphenoid, and bears a shallow groove on its posterior edge. These processes overlap the posterior end of the alveolar portion of the maxillary about 3 cm., to the edge of the alveolus for M^3 .

¹Measurements taken from illustrations by Depéret and Roman. The specimen may be crushed and thus give a low value. An adult skull gives a ratio of 0.45, but Dp^3 is missing.

The posterior portion of the skull has been broken off on a line through the occipitosphenoidal suture. Simpson has described a skull from the same beds (Fla. Geol. Surv. V-3211) in which the basioccipital and basisphenoid are fused; this is also the condition in the type of *Hesperosiren crataegensis*. In the present specimen the end surface of the basisphenoid shows the irregular and porous structure characteristic of open sutures. Sickenberg (p. 428) has stressed the general occurrence of a widely open suture at this point in the *Sirenia*, and shown that it may be related to other neotenic conditions in the skeleton which he attributes to hypothyroid metabolism. Simpson's record therefore appears unusual; perhaps these specimens were from extremely old or abnormal individuals.

Because of abrasion of the anterior edge of the premaxillaries, one cannot determine the extent of the median boss. There is definite indication of its presence, but it may have been smaller than in *F. serresi*. The angle of deflection of the rostrum appears about the same as in that species.

The sides of the naso-frontal region have been crushed inward somewhat, so that the narial opening appears narrower than it was in life. The aperture was elongate-oval, probably narrowing most gradually posteriorly. Depéret and Roman state that the external nares of *F. forestii* are narrower than those of *F. serresi*, but suspect that the difference may be due to crushing. *F. ossivalense* likewise appears to be narrower than *F. serresi* in this region, with some allowance for distortion. The nasal bones are exposed on the dorsal surface. They are widely separated, and, posteriorly at least, were separated from the nasal cavity by thin laminae of the frontal which are broken in the specimen but not improbably covered their medial surface.

The supraorbital processes are well preserved. Their surface is rugose, possibly due to abrasion of the surface bone. The temporal ridges extend forward onto the dorsal surface of these processes, which thus appear like horn-like extensions of the deeply cleft frontal. From the supraorbital processes the temporal ridges converge posteriorly, and nearly parallel one another along the angle between the top and side of the braincase. On the parietals they suddenly thicken opposite the extreme posterior point of the frontoparietal suture, the medial boundaries converging inward, the lateral turning out. At the narrowest point the outside width is 67 mm. A slight median boss is present on the frontal behind the nasal opening. Slight differences in detail between this specimen and that figured by Simpson (p. 450, fig. 13) are probably not significant. There is general agreement with the outline of the ridges in *F. forestii*.

The upper edge of the vomer bears a slight projecting ridge on either side which reaches the frontal and separates the respiratory

passage from the olfactory space. Above this ridge, on the sides of the mesethmoid, are traces of two or three pairs of turbinals. Their details could not be determined. Evidently the entire ossified portion of the mesethmoid is preserved, for its abruptly truncate anterior end bears evidence of cartilaginous extension, and is not broken. The vomer may have extended farther anteriorly. No trace of a separate orbitosphenoid bone could be observed.

There are two foramina in the upper side of the groove which extends forward from the large sphenoidal fissure to the orbit. The more anterior and smaller of these is situated deep in the groove 3 cm. anterior to the base of the pterygoid process. The internal openings of these foramina are on the floor of the braincase about 1 cm. from the base of the crista galli, directly behind the narrow fossae for the olfactory lobes. Shallow canals from them converge posteriorly. Apparently they carried the optic nerve and tract. A somewhat larger pair of foramina opens about 1 cm. behind the optic, near the outer edge of the groove. The internal openings lie at the edge of the floor of the braincase slightly anterior and lateral to the optic foramina.

Pachyostosis and osteosclerosis are shown by the various skull elements, particularly the parietals, as in other dugongids.

Measurements of *Felsinotherium* skull.

	cm.
Length, occipitosphenoidal suture—premaxillary boss	27
Length, anterior border of posterior nares to base of flared portion of rostrum	14
Length anterior narial opening	19
Length maxillary	20
Length supraorbital process, from back end narial opening.	9
Minimum width, diastema region	6.2
Width between opposite M ² s	1.8
Depth, parietal to basisphenoid	11

DISCUSSION

It has been pointed out that the specimen described above compares more closely with *Metaxytherium cuvieri* than with the European species of *Felsinotherium* in the elongation of the proximal portion of the rostrum, and in the weak development of ridges on the anterior part of the palate. The ratio of length M³/width M³, 1.24, agrees far better with various species of *Metaxytherium* than with *Felsinotherium*. The relatively narrow posterior portion of M³, compared to the anterior portion, also resembles *M. cuvieri*. Other resemblances, of doubtful importance, are the narrowness of the external nares compared to *F. serresi*, and possibly the presence of somewhat larger nasals than in that species. The size is closer to that of *M. cuvieri* than to *F. serresi*, but *F. forestii* is also of large size. No importance can be attached to size

differences of the magnitude involved in determining generic relationships.

On the other hand the greater deflection of the rostrum in the Florida specimen, and the cusp development of the molar teeth approach *F. serresi* more closely than *M. cuvieri*.

Simpson assigned the Pliocene sirenians from Florida to *Felsinotherium* rather than to *Metaxytherium* because "in most or all of the principal characters permitting or close comparison they seem rather more advanced and more on a par with *Felsinotherium*" (p. 469). Among the characters mentioned are certain doubtful characters of the teeth (one of which does not hold for this specimen), the form of the supraoccipital and its relationship to the toramen magnum, the form of the temporal ridges, the similar deflection of the rostrum in this specimen and *F. serresi*, and a number of postcranial characters. He recognized also that there were close resemblances to *Metaxytherium* in other characters, and stressed the difficulty of defining these genera, which are separated on degree of phyletic evolution alone.

The presence of two species of dugongids in the Bone Valley Pliocene, in neither of which is the dentition associated with the posterior portion of the cranium or postcranial skeleton, adds to the difficulty of determining the generic affinities of these animals. It is possible that the occiput and postcranial elements which Simpson considered more like *Felsinotherium* than *Metaxytherium* all pertain to *F. floridanum*, and that *F. ossivalense* is more primitive and comparable to *M. cuvieri* in those parts, as well as in the anterior portion of the skull. If further discoveries show this to be true, it will be necessary to refer the species to *Metaxytherium*. But if the advanced features of the supraoccipital and other portions of the skeleton are combined with the *Metaxytherium*-like features mentioned above in one species, its generic allocation becomes a matter of uncertainty and individual choice. It is probable that the form of the supraoccipital is of greater significance as an indication of advancement than the elongation or angle of the rostrum. But the proportions of the teeth likewise merit serious consideration.

Possibly the most feasible solution of the taxonomic problem would be to regard the differences between Miocene and Pliocene Halitheriinae as too slight and variable to be worthy of generic recognition, and to place the species now referred to *Felsinotherium* in *Metaxytherium*, recognizing that some species of that genus showed certain evidence of advancement over their earlier relatives. Until more material is available, a formal proposal of this nature would be premature. At present, then, the specimen described above may be referred to Simpson's species, *F. ossivalense*, but the generic reference remains open to doubt until better specimens are discovered.

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(Contains extensive bibliography on Sirenia).

PLATES I-II

PLATE I.

Photograph of left side of anterior portion of skull, x $\frac{1}{2}$.





PLATE II

Photograph of top of rostral portion of skull, x $\frac{1}{2}$.

