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Upper Eocene Snakes (Reptilia, Serpentes) from Georgia

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ABSTRACT—A small fossil assemblage from the Upper Eocene (Twiggs Clay) of Twiggs County, Georgia, has yielded a pelobatid frog, two large sea snakes (*Palaeophis* and *Pterosphenus*) and two terrestrial erycinine boids (*Huberophis georgiensis* n. gen. et sp. and *Ogmophis voorhiesi* n. sp.). Both the stratigraphy and vertebrate fauna suggest that an estuary on a tropical coastline was the site of deposition of the bones.

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INTRODUCTION

Fossil land mammals collected by Dr. Michael Voorhies, formerly of the University of Georgia, from the Upper Eocene of the Twiggs Clay, Twiggs County, Georgia, suggest a Duchesnean (latest Eocene) age in terms of the North American land mammal sequence. Among the mammalian fossils were the remains of an anuran and several snakes. These fossils represent both marine and terrestrial animals and a detailed report on these bones forms the basis of the present paper.

THE SITE

The fossils were taken from an abandoned Kaolin (Clay) Pit (Pit No. 22, J. M. Huber Corporation) from approximately 9 mi SSE of Macon and 4 mi ENE of Huber, Twiggs County, Georgia. The fossils were recovered from a lens of red sandy clay 50 ft above the base of the Twiggs Clay. A geologic section of this site has been published by Carver (1972). The fossils are from Unit 13 of Carver's section. The Twiggs Clay is thought to be Jacksonian (Upper Eocene) in terms of the Gulf Coast marine provincial time-stratigraphic scale. Huddlestun, Marsalis and Pickering (1974) report that the Twigs Clay lies within Planktonic Foraminifera Zone P16 which is late, but not latest Eocene. On the other hand, Voorhies (*in litt.,* Sept. 1975) states that the land mammals from the Twiggs Clay suggest a Duchesnean or earliest Eocene age in terms of the North American land mammal sequence. In any case, in general terms, both the Foraminifera and the land mammals indicate Upper Eocene times.

SYSTEMATIC PALEONTOLOGY

Class Amphibia
Order Anura
Family Pelobatidae

Pelobatidae indet.

Material.—Partial left ilium, partial tibiofibula, distal portion of humerus, University of Georgia Vertebrate Paleontology No. 46.

Remarks.—This fragmentary anuran material is assigned to the family Pelobatidae based of the shape of the ilium, the fact that the ilium lacks a dorsal prominence, and on the basis of the tibiofibula which is constricted at its middle. The distal part of the humerus is tentatively

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assigned to the pelobatidae based on the fact that it is from an individual of about the size as the one represented by the ilium and the tibiofibula. The only pelobatids previously reported from the Eocene are forms of the genus *Eopelobates* Parker which is from the early and middle Eocene of Wyoming (Estes, 1970). It is possible that Georgia bones represent a small *Eopelobates.*

Class Reptilia
Order Squamata
Family Palaeophidae

Romer (1956) provisionally placed the Palaeophidae with the lizards, including the genera *Palaeophis, Pterosphenus, Simoliophis,* and *Pachyophis.* Auffenberg (1959) proposed that *Palaeophis* and *Pterosphenus* be recognized as snakes, and that they constitute a distinct family (Palaeophidae) distinguished on the basis of well-developed pterapophyses and double hypapophyses in some vertebrae. Romer (1966) includes *Palaeophis* and *Simoliophis* in his section on snakes in the text, but he places them with the varanoid lizards in his classification at the end of the book. Romer states "Again, in the Cretaceous and Eocene we find a number of poorly known forms, such as *Paleophis* and *Simoliophis* which appear to have had elongate snakelike bodies, but vertebrae more on the pattern of monitor lizards; quite possibly these, if better known, would be found to represent a group truly intermediate between the snakes and their lizard ancestors, but their marine habitat renders this improbable."

I consider *Palaeophis* and *Pterosphenus* to be unquestionably snakes. Certainly their vertebrae are not monitorlike, but are strongly boalike with marine specializations. *Palaeophis* and *Pterosphenus* have a well-developed zygosphene-zygantrum complex and rounded centra, cotyla, and condyles. Monitors lack a zygosphene-zygantrum complex and have flattened centra, cotyla, and condyles. Hoffstetter and Gasc (1969) point out characters which separate snakes from those lizards that have a zygosphene-zygantrum complex. These characters are found in *Palaeophis* and *Pterosphenus* and are as follow: (1) zygosphene-zygantrum articular surface widened dorsally, overhanging, forming an angle of less than 90 degrees when articulating with one another, (2) zygosphene-zygantrum articular surfaces separated from each other by a non-articular area, and (3) dorsal border of zygosphene never deeply notched.

Palaeophis and *Pterosphenus* have strong vertebral characters that indicate relationships to the Boidae. These are: (1) anterior border of zygosphene narrow and thick, (2) vertebra higher than long, (3) postzygapophyseal part of neural arch upswept, (4) foramina lacking on either side of cotyle, and (5) neural spine thick, at least at its base. Two characters of the Boidae vertebral column that differ from *Palaeophis* and *Pteropshenus* are (1) vertebrae wider than long, and (2) subcentral ridges strong and arched upward. In *Palaeophis* and *Pterosphenus* the vertebrae are longer than wide and the subcentral ridges are weak or absent and not arched upward. Added to this, the strong pterapophyses and double hypapophyses of these forms indicate a different group. I would suggest that *Palaeophis* and *Pterosphenus* be considered as specialized marine offshoots of the Boidae, but still in the distinct family Palaeophidae.

Status of *Palaeophis* and *Pterosphenus*

I am here recognizing the two genera *Palaeophis* and *Pterosphenus,* but until fully articulated, complete vertebral columns of these forms are found, I am not convinced that *Palaeophis* and *Pterosphenus* do not represent variations along the vertebral column of a single form.

Palaeophis virginianus Lynn

Material.—Vertebra, UGV 53, Fig. 1 A,B,C.

Remarks.—This vertebra is assigned to *Palaeophis* rather than to *Pterosphenus* in that it has shorter pterapophyses and in that the planes of the articular facets of the prezygapophyses lie well above the level of the floor of the neural canal (Gilmore, 1938:59). The vertebra is

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similar to *P. virginianus* and differs from other North American *Palaeophis* in having a posterior hypapophyseal tubercle only.

Pterosphenus schucherti Lucas

Material.—A large (UGV 52a, Fig. 1 D,E,F) and a small (UGV 52b) vertebra.

Remarks.—These vertebrae have very elongate pterapophyses and the planes of the articular facets of their prezygapophyses are at a level with the floor of the neural canal. Both vertebrae have a double hypapophysis connected by a keel. The large vertebra (Fig. 1 D,E,F) is remarkably complete and is so similar to *Pterosphenus schucherti* (Gilmore, 1938:57, pl. 4, and Fig. 22) that it is assigned to this species. The smaller vertebra is also assigned to *P. schucherti.*

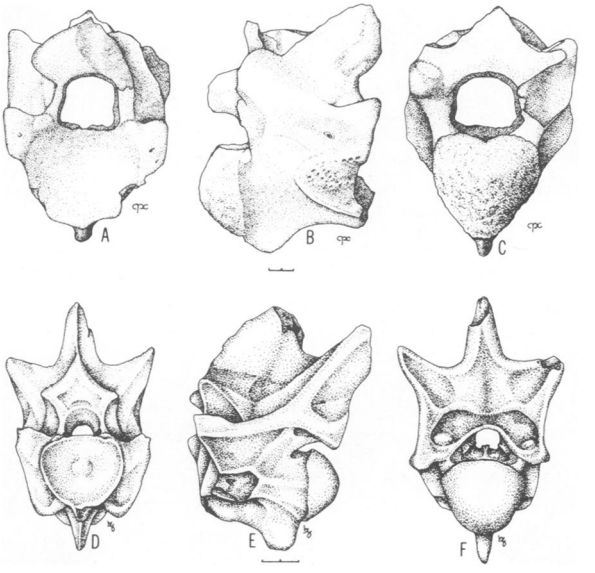

FIGURE 1. Vertebrae of *Palaeophis virginianus* UGV 53 (A, anterior, B, lateral, C, posterior) and *Pterosphenus schucherti* UGV 52a (D, anterior, E, lateral, F, posterior). Top line equals 2 mm, bottom line equals 6 mm.

Family Boidae
Subfamily Erycinae

Huberophis n. gen.

Diagnosis.—A distinctive genus of large erycinine boid, distinguished from other genera on the basis of having: (1) the vertebra about as long as wide, (2) its neural spine very low and short, (3) its hemal keel wide and strong, (4) subcentral ridges well-developed, (5) grooves between hemal keel and subcentral ridges quite deep, and (6) accessory processes absent.

Huberophis georgiensis n. sp.

Diagnosis.—Differs as the genus.

Holotype.—Trunk vertebra, UGV 51, Fig. 2.

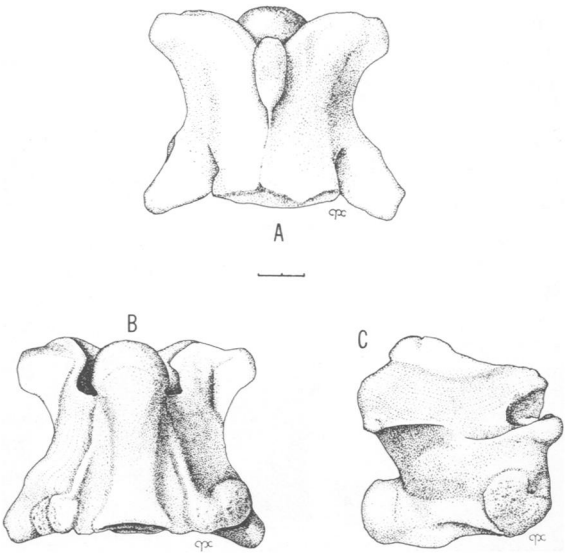

FIGURE 2. Vertebra of *Huberophis georgiensis* UGV 51, holotype of new genus and species (A, dorsal, B, ventral, C, lateral). Line equals 2 mm.

Description of the holotype.—In dorsal view, the vertebra is about as long as it is wide. The neural spine is short and thick and is less than one-half as long as the greatest length of the neural arch. The prezygapophyseal articular faces are ovaloid. The prezygapophyseal accessory processes are absent. The anterior edge of the zygosphene is convex. In lateral view, the parapophyseal and diapophyseal portions of the paradiapophyses are not distinct from one another. The subcentral ridges are strongly arched upward. The postzygapophyseal portion of the neural arch is upswept. The neural spine is about twice as long as it is high. The hemal keel is deflected downward

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posteriorly. In anterior view, the zygosphene is narrow and thick. The top of the zygosphene is slightly convex. The round cotyle is larger than the subtriangular neural canal. The fossae on either side of the cotyle lack foramina. The prezygapophyses are moderately tilted upward. In ventral view, the hemal keel is wide and distinct; it is constricted slightly at its middle. The grooves between the hemal keel and the subcentral ridges are deep. The subcentral ridges are very strongly developed. The postzygapophyseal articular facets are rounded. In posterior view, the neural spine is low and thick. The neural arch is vaulted. The round condyle is about the same size as the round neural canal.

Remarks.—Based on its low, short neural spine *Huberophis* resembles *Calamagras,* also known from the Eocene of North America, but *Huberophis* differs from *Calamagras* in several respects, including: (1) much larger size, (2) stronger hemal keel, (3) deeper grooves between the hemal keel and subcentral ridges, and (4) much stronger subcentral ridges. Perhaps *Calamagras* and *Huberophis* had an earlier common ancestor that gave rise to the small *Calamagras* and the larger *Huberophis.*

Ogmophis voorhiesi n. sp.

Diagnosis.—An *Ogmophis* that is most similar to *Ogmophis compactus* Lambe of the lower Oligocene of the Cypress Hills Formation of Saskatchewan, but differs in: (1) being much smaller, (2) lacking accessory processes of the prezygapophyses, (3) having a wider hemal keel, and (4) having much less distinct subcentral ridges.

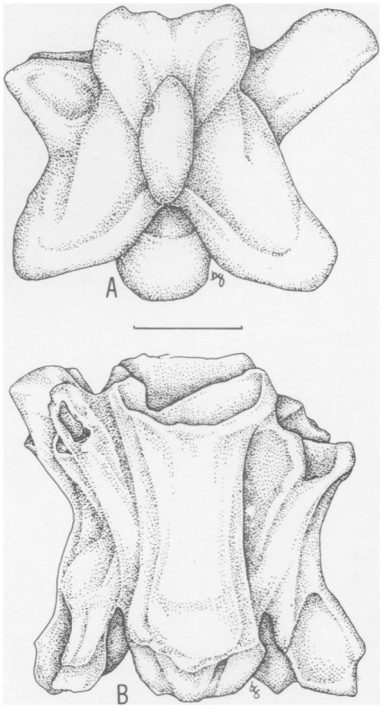

FIGURE 3. Vertebra of *Ogmophis voorhiesi* UGV 47, holotype of new species (A, dorsal, B, ventral). Line equals 1 mm.

Holotype.—Trunk vertebra, UGV 47, Fig. 3.

Paratypes.—Two trunk vertebrae, UGV 48 and 49.

Etymology.—Named in honor of Dr. Michael Voorhies of the University of Nebraska State Museum.

Description of the holotype.—In dorsal view, the vertebra is about as wide as it is long. The neural spine is long and thick. It is more than one-half as long as the greatest length of the neural arch. The neural spine is thicker in its posterior two-thirds than it is anteriorly. The anterior edge of the zygosphene is concave, but it has an irregular edge due to breakage. The prezygapophyseal articular faces are oval. Prezygapophyseal accessory processes are absent. The posterior margin of the neural arch is V-shaped. In lateral view, the postzygapophyseal part of the neural arch is upswept. The neural spine is about twice as long as it is high. The subcentral ridges are curved sharply upward. In anterior view, the zygosphene is narrow and thick. The neural spine is low and thick. The subtriangular neural canal is about the same size as the round cotyle. The prezygapophyses are moderately tilted upward. The paradiapophyses are not clearly divided into parapophyseal and diapophyseal portions. The depression on the right side of the cotyle appears to lack a fossa. The area on the left side of the cotyle is damaged. In ventral view, much of the ventral part of the centrum is damaged, but the hemal keel is wide and strong. The left postzygapophyseal area is damaged, but the right postzygapophyseal facet is oval. In posterior view, the neural spine is low and thick. The subtriangular neural canal is larger than the condyle which is partially eroded. The neural arch is moderately vaulted.

Paratypes.—The paratypes do not differ from the holotype in important features.

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COMMENT

Both *Palaeophis* and *Pterosphenus* are considered to have been sea snakes, but the pelobatid frog, the medium-sized boa (*Huberophis*), and the small boa (*Ogmophis*) were almost certainly terrestrial forms. Thus, the suggestion by Voorhies (*in litt.,* Sept., 1975) that the stratigraphy and the vertebrate fauna indicates a tropical coastline is supported by the herpetological remains. The boas and the very large sea snakes would indicate semitropical or tropical conditions, and the admixture of marine and terrestrial forms would indicate an estuarine situation or a river mouth.

ACKNOWLEDGMENTS

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