NEW TEIID LIZARDS FROM THE UPPER CRETACEOUS OLDMAN FORMATION (JUDITHIAN) OF SOUTHEASTERN ALBERTA, CANADA, WITH A REVIEW OF THE CRETACEOUS RECORD OF TEIIDS

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ABSTRACT

Four new genera and five new species of Teiidae (Lacertilia), based on newly discovered specimens from the Upper Cretaceous Oldman Formation (Judithian), Alberta, Canada, are named and described. A brief review of the Cretaceous record of the Teiidae in both North America and central Asia is presented. Recognition of the new teiids and work in progress shows that, contrary to previous authors, the North American Judithian lizard fauna is significantly different taxonomically from that of Lancian age and, hence, represents a previously unrecognized episode in the evolutionary history of teiids. The stratigraphic distribution of teiid fossils in the Cretaceous of North America suggests that the unicuspoid tooth form is primitive for the family Teiidae.

INTRODUCTION

Although the Oldman Formation (Russell and Landes, 1940) of Alberta has yielded a large vertebrate fauna, lizards are poorly known compared to dinosaurs and other vertebrates from the formation. The earliest report concerning terrestrial lizards from the Oldman Formation was in 1923, when Gilmore referred a dorsal vertebra (UA 112) to a "lacertian" (=lacertilian). The specimen was collected by G. F. Sternberg in 1921 from Sandy Point, South Saskatchewan River, north of Medicine Hat. Subsequently, Gilmore (1928) referred this specimen to Palaeosaniwa canadensis, a large varanid, and Russell (1964) and Langston (1965) included Palaeosaniwa canadensis in their lists of Oldman vertebrate species. The first report on teiids from the Oldman Formation was by Waldman (1970), who described a lower jaw (NMC 13563) from a locality near Steeveville, southeastern Alberta, referring it to Chamops sp. (see later discussion on the specimen in this paper). Other records of teiids are included in faunal lists given by Fox (1976), Currie (1986), Eberth (1987), and Koster et al. (1987). The Judithian age of the Oldman Formation was established by Russell (1964, 1975; and see Lillegraven and McKenna, 1986). The Judithian Land Mammal Age is approximately equivalent to mid-Campanian time (Russell, 1975; Eberth, 1987); beds containing Judithian vertebrates in Alberta and Montana have yielded radiometric ages from 74 to 78 my (Eberth, 1987; Goodwin and Deino, 1989; Thomas et al., 1990).

This paper describes several new teiids from the Oldman Formation, Alberta,  

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and presents a brief review of the Cretaceous record of the family. Four new genera and five new species are named herein, based on specimens collected from the Irvine and Railway Grade localities, southeastern Alberta (legal descriptions below). Recognition of these new taxa and work in progress on others shows that, contrary to previous authors (Sahni, 1972; Armstrong-Ziegler, 1980; Sullivan, 1981; Estes, 1983a), the North American Judithian lizard fauna is significantly different taxonomically from that of Lancian age (see Estes, 1964, 1983a; Estes et al., 1969), resembling in that respect the mammalian fauna, which has fewer than 10% of the species in common between Judithian and Lancian horizons (see Lillegraven and McKenna, 1986). Detailed description and more extensive discussion of the taxa named here will be published elsewhere as part of a monographic treatment of lizards from the Upper Cretaceous of western Canada being undertaken by the first author.

Terminology used in the text follows Estes (1964, 1983a), but with some terms explicitly defined as follows: inferior alveolar foramina—a row of mental foramina located along the lateral surface of the dentary; subdental shelf—a shelf-like medial extension of the dentary below the tooth row (often contributing to the splenodentary articulation); subpleurodont—attachment of the marginal teeth to the medial surface of the lateral parapet, which remains low (one half or less of crown height, a condition commonly seen in teiids); sulcus dentalis—also called “dental gutter”, a groove developed medial to the tooth bases, separating the tooth row from the subdental shelf.

Institutional abbreviations are as follows: UALVP (=UA), Laboratory for Vertebrate Paleontology, Departments of Geology and Zoology, University of Alberta, Edmonton, Alberta, Canada; NMC, National Museum of Natural Science, Ottawa, Ontario, Canada; UCMP, University of California Museum of Paleontology, Berkeley, California, U.S.A.; UNM, University of New Mexico, Albuquerque, New Mexico, U.S.A.; SMU, Southern Methodist University, Dallas, Texas, U.S.A.; YUM (=YPM), Peabody Museum of Natural History, Yale University, New Haven, Connecticut, U.S.A.

**Systematic Paleontology**

Class Reptilia Linnaeus, 1758  
Subclass Diapsida Osborn, 1903  
Infraclass Lepidosauromorpha Benton, 1983  
Superorder Lepidosauria Haecikel, 1866  
Order Squamata Oppel, 1811  
Suborder Lacertilia Owen, 1842  
Infraorder Scincomorpha Camp, 1923  
Family Teiidae Gray, 1827 (sensu Estes, 1983a; Presch, 1983)

Boulenger (1885) subdivided the family Teiidae (sensu lato) into four groups. Lizards in “group I” were later informally designated as “macroteiids”, and those in “groups II–IV”, “microteiids” (Ruibal, 1952; MacLean, 1974). MacLean (1974) and Presch (1974a) recognized macroteiids and microteiids as separate subfamilies (Teiinae and Gymnophthalminae). More recently, Estes (1983a) and Presch (1983) independently ranked the two groups as families. Teiidae (sensu stricto) in this paper refers to Boulenger’s group I, and is used in the sense of Estes’ (1983a) and Presch’s (1983) definition. In the most recent study of the phylogenetic relationships of the lizard families, Estes et al. (1988)
recognized 14 synapomorphies for the family Teiidae, among which the following are unambiguous and reliable character states for fossil teiid studies: replacement teeth developing in deep subcircular cavities at tooth bases (Romer, 1956); cementum deposited extensively on tooth bases (Presch, 1974b); vomers elongate, approaching pterygoids (Romer, 1956); splenial large, extending anteriorly to the symphysis, leaving only a small symphyseal foramen (MacLean, 1974). We note as well that teiids often exhibit a well-developed sulcus dentalis and subdental shelf (Estes et al., 1988), character states that are often useful in determining the affinities of species that are represented by the incomplete jaws that make up most of the North American record of identifiable Cretaceous lizards.

For the higher classification of lizards we follow Carroll (1988a) in the belief that an important attribute of classifications is retention of relative stability to permit ease of communication (see Martin, 1990:99), even in the face of changing views of cladistic relationships (compare, e.g., Benton, 1985; Carroll, 1988b; Gauthier et al., 1988; Estes et al., 1988).

**Glyptogenys**, new genus

*Type species.* — *Glyptogenys ornata*, new species.

*Diagnosis.* — As for the type and only known species.

*Etymology.* — *glyptos* + *genys* (Gr.), meaning “carved jaw”, in reference to the ornamented dentary of this lizard.

**Glyptogenys ornata**, new species

(Fig. 1)

*Holotype.* — UALVP 29735, anterior part of a left dentary bearing 12 well-preserved teeth, only known specimen.

*Type locality and horizon.* — Outcrop of the Oldman Formation near Irvine, in S 31, Tp. 11, R 2, W 4, about 40 km east of Medicine Hat, southeastern Alberta.

*Age.* — Late Cretaceous (Judithian).

*Diagnosis.* — A teiid lizard that differs from other fossil and Recent teiids in having the following combination of characters: dentary deep, massively built, and heavily ornamented below inferior alveolar foramina in at least adult individuals; subdental shelf deep and robust; teeth subpleurodont, with lateral parapet about half of crown height; crowns mostly bicuspid with main cusp in posterior position on crown and anterior cusp low and rounded; anterior teeth unicusp and more nearly conical; tooth bases compressed anteroposteriorly, with thick, ring-like basal deposit of cementum.

*Etymology.* — *ornata* (L.), meaning “ornamented”, in reference to the sculpture on the external surface of the holotype.

*Remarks.* — Although several uncatalogued specimens in the UALVP collections show a jaw configuration that resembles that of the holotype, they are too fragmentary to be referred to *Glyptogenys ornata* with complete certainty, leaving UALVP 29735 to be the type and only known specimen for this new lizard at present.

The assignment of *Glyptogenys ornata* to the family Teiidae is mainly founded on the conspicuous basal deposit of cementum around the tooth bases, and the presence of a hypertrophied splenial that extends well anteriorly as indicated by the widely open Meckelian sulcus in the holotype. These are diagnostic characters of the Teiidae (MacLean, 1974; Presch, 1974b; Estes, 1983a; Estes et al., 1988). Other characters shown by the holotype and often occurring in teiids, such as the
subpleurodont dentition, enlarged bicuspid teeth, well-developed subdental shelf, and sulcus dentalis (see, e.g., Estes, 1964; Winkler et al., 1990), reinforce our conclusion that *G. ornata* is a teiid. *G. ornata* can be readily distinguished from Lancian *Chamops segnis* Marsh 1892, which is similar in size, by its bicuspid, closely-spaced, and somewhat recurved dentary teeth that lack swollen, barrel-like shafts; further, the dentary of *G. ornata* is deeper anteriorly, while that of *Chamops* lacks sculpture (Estes, 1964).
**Socognathus**, new genus

*Type species.* — *Socognathus unicuspis*, new species.

*Diagnosis.* — As for the type and only known species.

*Etymology.* — *sokos* + *gnathos* (G.), meaning "strong jaw".

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**Socognathus unicuspis**, new species

*(Fig. 2)*

*Holotype.* — UALVP 29739, an incomplete left dentary bearing 11 well-preserved teeth and bases of six others.

*Type locality and horizon.* — Railway Grade, Dinosaur Provincial Park, in S 22, Tp. 20, R 12, W 4, southeastern Alberta; Oldman Formation.

*Age.* — Late Cretaceous (Judithian).

*Referred specimens.* — UALVP 29736, 29740, 29743–45 (total: 5); all are in-
complete dentaries bearing teeth and broken tooth bases, and all were collected from the Irvine locality.

**Diagnosis.** — Relatively large teiid differing from other teiids in having the unique combination of the following characters: dentary long and robust; mandibular symphysis strongly enhanced by ventral bony buttress; teeth unicuspid, slightly compressed anteroposteriorly, and mostly large, but variable in spacing and recurvature of crowns; tooth attachment subpleurodont, with lateral parapet low, about one-third of crown height; crowns with moderately strong anterior ridge and weaker posterior ridge curving ventrolingually from apical cusp.

**Etymology.** — *unicuspis* (L.), in reference to the single-cusped dentary teeth of this lizard.

**Remarks.** — *Socognathus unicuspis* is founded on six relatively well-preserved specimens, four left and two right dentaries; several uncatalogued, more fragmentary dentaries are also in the collection from both Railway Grade and Irvine localities. Together, the type and referred specimens allow reconstruction of the proportions of the dentary of *S. unicuspis* posteriorly to the most posterior tooth position. These proportions differ significantly from those of the dentary of *Glyptogenys ornata*, the other relatively large teiid from the Oldman Formation, Alberta; the lack of sculpture and the irregularly developed dentition also contrast with *Glyptogenys*. The combination of large, irregularly spaced, nearly conical, unicuspid teeth and the strong mandibular symphysis enhanced by the bony buttress is unique among known teiids of Late Cretaceous age; the buttress is more prominent in larger specimens of *S. unicuspis* and contrasts with the absence of a comparable structure in the dentaries of *Glyptogenys* and *Leptochamops*, for example, among Cretaceous teiids. The large size of this lizard and the tendency of the teeth to increase in size posteriorly (resulting in a certain degree of heterodonty), may suggest relationship with the subfamily Tupinambinae, which includes the Recent genera *Tupinambis*, *Callopistes*, *Crocodilurus*, *Dracaena*, and fossil *Chamops* (Presch, 1983).

**Sphenosiagon**, new genus

*Type species.* — *Sphenosiagon simplex*, new species.

**Diagnosis.** — As for the type and only known species.

**Etymology.** — *sphen* + *siagon* (Gr.), meaning "wedge jaw", in reference to the shape of the lower jaw of this lizard.

**Sphenosiagon simplex**, new species

(Fig. 3)

*Chamops* sp. Waldman, 1970:546, fig. 2–3.

**Holotype.** — UALVP 29742, a fragmentary left mandible having splenial firmly articulated with the dentary, and having eight posterior teeth and the base of the last dentary tooth.

**Type locality and horizon.** — Outcrop of the Oldman Formation near Irvine, in S 31, Tp. 11, R 2, W 4, about 40 km east of Medicine Hat, southeastern Alberta.

**Age.** — Late Cretaceous (Judithian).

**Referred specimen.** — NMC 13563, a right mandibular ramus from the Oldman Formation near Steveville, southeastern Alberta (Waldman, 1970).

**Diagnosis.** — Differing from other known teiids, including Lancian *Chamops segnis*, in having the unique combination of the following characters: dentary
slender, lightly built, and wedge-shaped; subdental shelf narrow; sulcus dentalis poorly defined; teeth unicuspid; tooth attachment subpleurodont, with lateral parapet about half of crown height.

Etymology. —simplex (L.), in reference to the simple tooth form of this lizard.

Remarks. —The referral of UALVP 29742 to the family Teiidae is indicated by several characters shown on the specimen, including a large splenial and the extensive basal deposit of cementum around the tooth bases.

In 1970, Waldman described an incomplete right mandible of a lizard (NMC 13563) from the Oldman Formation, near Steveville, Alberta. The specimen was originally identified as Chamops sp. (Waldman, 1970), but was subsequently referred to the Lancian species, Chamops segnis (Estes, 1983a). Our restudy of the specimen indicates that it is best referred to Sphenosiagon, not to Chamops.
A comparison of NMC 13563 with the holotype of *S. simplex* shows that the two specimens are closely similar: they show the same unique jaw shape, the same development of the splenial, a slender subdental shelf, poorly defined sulcus dentalis, and the same type of tooth attachment; clearly, NMC 13563 belongs to *S. simplex*. The tooth crowns on NMC 13563 have been partially dissolved diagenetically; however, those on UALVP 29742 are unambiguously unicuspid, not tricuspid, as in *C. segnis*, nor do the crowns display the barrel-like proportions that Estes (1983a: fig. 22) illustrated for NMC 13563; in fact, Estes' (1983a) figure of NMC 13563 differs substantially from that of Waldman (1970: fig. 2), which is the more accurate, and has been drawn so that it appears to be more *Chamops*-like than it is. For example, no “surangular window” is preserved on NMC 13563 (see Estes, 1983a), and the “coronoid”, which both Waldman (1970) and Estes (1983a) have shown, is actually a broken part of the jaw glued into the position of a coronoid (Gao, in progress). Hence, Estes' (1983a) conclusion that *Chamops* is a member of the Tupinambini must come from evidence other than that provided by this specimen, which does not pertain to *Chamops*.

**Gerontoseps**, new genus

*Type species.* — *Gerontoseps irvinensis*, new species.  
*Diagnosis.* — As for the type and only known species.  
*Etymology.* — gerontos + seps (Gr.), meaning “old man lizard” (lizard from the Oldman Formation).

**Gerontoseps irvinensis**, new species

(Fig. 4)

*Holotype and only known specimen.* — UALVP 29754, an anterior part of a right mandible having three complete and ten broken teeth.  
*Type locality and horizon.* — Outcrop of the Oldman Formation near Irvine, in S 31, Tp. 11, R 2, W 4, about 40 km east of Medicine Hat, southeastern Alberta; Oldman Formation.  
*Age.* — Late Cretaceous (Judithian).  
*Diagnosis.* — A small species differing from other Late Cretaceous and Recent teiids in having the following combination of characters: dentary shallow but wide, convex both laterally and medially; splenial fused to dentary; sulcus dentalis narrow and conspicuously deep; teeth unicuspid and nearly conical, but having symmetrical anterior and posterior ridges; tooth attachment subpleurodont, with lateral parapet about one-third of crown height.  
*Etymology.* — Irvine, place name, in reference to the village near the type locality.  
*Remarks.* — One of the most obvious characters of the holotype is the cosification between the well-developed splenial and the dentary along the dorsal splenodentary suture; splenodentary fusion is characteristic of xantusiid lizards and is also seen in the Lancian teiid *Haptosphenus* (Estes, 1964), both of which are very different from UALVP 29754 in other aspects of jaw construction and dentition. We interpret this fusion as taxonomically significant, owing to the small size of UALVP 29754 and the low probability that such extensive fusion would occur in a still young individual of a species in which adult size was significantly larger than is indicated by the dimensions of UALVP 29754. The deep sulcus dentalis and unicuspid crowns are other features that allow UALVP 29754 to be readily distinguished from the dentaries of other Late Cretaceous teiids. The deep sulcus, well-developed subdental shelf and splenial, and prominent subcircular
basal replacement pits (at five tooth positions on UALVP 29754) are all consistent with classification of *Gerontoseps* in the Teiidae.

*Leptochamops* Estes, 1964

*Leptochamops thrinax*, new species

(Fig. 5)

*Holotype.* — UALVP 29749, an incomplete left dentary bearing five teeth and bases for ten others.

*Referred specimens.* — UALVP 29748, 29750, 29753; all are incomplete dentaries having several teeth preserved and collected from the Irvine locality.

*Type locality and horizon.* — Outcrop of the Oldman Formation near Irvine, in S 31, Tp. 11, R 2, W 4, about 40 km east of Medicine Hat, southeastern Alberta.

*Age.* — Late Cretaceous (Judithian).

*Diagnosis.* — A species of *Leptochamops* differing from the Lancian *L. denticula-
Fig. 5.—Leptochamops thrinax new species, Oldman Formation (Judithian), Upper Cretaceous, UALVP 29749 (holotype), incomplete left dentary; (above) lateral view, (below) medial view. Scale = 5 mm.

tus in having strongly tricuspid, widely spaced, and fewer dentary teeth; and having a nearly straight tooth row, lacking the characteristic curvature seen in the Lancian species; tooth attachment subpleurodont, with lateral parapet one-half to one-third of crown height and decreasing posteriorly.

Etymology.—thrinax (Gr.), in reference to the broadly tricuspid teeth of this species.

Remarks.—The holotype, UALVP 29749, shows characters, such as long, shallow symphysis, shallow dentary, shallow Meckelian sulcus, and high crowned, straight, and columnar tricuspid teeth, that indicate it is referable to the genus Leptochamops Estes 1964; but these same features readily distinguish the type and referred dentaries of L. thrinax from those of the other teiids from the Oldman Formation described above, including Gerontoseps, which evidently was similar in size. When compared to L. denticulatus, a Lancian species, its strongly tricuspid, widely spaced dentary teeth (which are also fewer in number) and straight tooth row indicate that the specimen represents a new species of the genus. The inclusion of UALVP 29750 and 29753 in this species is based on their similar jaw configuration, tooth number, and straight tooth row; the tooth crowns on the latter two specimens are partly dissolved away. Another specimen, UALVP 29748, shows
the same distinctive cusp pattern and jaw configuration as the holotype, but has tooth bases that are more swollen, and is larger; these differences appear best interpreted as ontogenetic, and we include UALVP 29748 in *L. thrinax* accordingly.

**Review of the Cretaceous Record of Teiids**

The family Teiidae (*sensu* Estes, 1983a; Presch, 1983) includes about 20 genera, half of which are extinct (Presch, 1983). This paper adds four new genera and five new species; four of these species exhibit a lower dentition in which the crowns are unicuspid or weakly bicuspid, which may be a more primitive configuration than the tricuspid tooth form that is most common in Lancian and Recent species. The distribution of the Recent teiid genera is restricted to Central and South America with the exception of *Cnemidophorus*, which occurs in North America (e.g., Presch, 1974a). However, the fossil record of Teiidae indicates that the family probably originated sometime during the Early Cretaceous in North America, underwent a radiation in both North America and Central Asia during the Late Cretaceous, and then experienced a sharp decline in latest Cretaceous time. Ancestors of the nine Recent genera of the family (see Presch, 1983) may have invaded Central and South America sometime during the Late Cretaceous or Early Tertiary (Presch, 1974a, 1980, 1983; Estes, 1983b; Estes and Baez, 1985).

**Early Cretaceous record.** —The only known Early Cretaceous record of teiids is from the Comanchean of central Texas. Murry et al. (1989) reported the discovery of small tetrapods from the Twin Mountains, Glen Rose, and Paluxy formations (=Trinity Group). The description of this fauna was published by Winkler et al. (1990), in which several lizard jaws (SMU 72282, 72283, 72301) were referred to the family Teiidae (questionably subfamily Teiinae), but no identifications at generic and specific levels were attempted. These jaws show synapomorphies of the Teiidae such as extensive deposits of cementum around the tooth bases (see Winkler et al., 1990: fig. 6c) and a hypertrophied splenial, as indicated by the widely open Meckelian canal. In addition, other characters, such as the subpleurodont tooth attachment, well-developed subdental shelf and sulcus dentalis, are also indicative of the family Teiidae (Winkler et al., 1990). However, the teeth of these specimens are unicuspid (Winkler et al., 1990), suggesting to us that the unicuspid coronal pattern is primitive for the family (see above). According to Winkler et al. (1990), other jaws from the Comanchean of Texas resemble those of the Upper Jurassic paramacellodids (see Estes, 1983a, 1983b), indicating that the Comanchean materials may represent a transitional lizard assemblage between those of the Upper Jurassic and Upper Cretaceous.

**Late Cretaceous record.** —The Late Cretaceous was probably the most important interval for the early diversification of teiids (see Estes, 1983a, 1983b), as indicated by the fossil record from North America, the Gobi Desert, and possibly elsewhere in Asia (Fig. 6):

**Uzbekistan:** Nessov (1985, 1988) questionably assigned *Buckantaus crassidens* from the middle part of Taikarshin beds, Dzharakhuduk locality, Uzbekistan, to the Teiidae and identified other materials from the upper part of the Jalovatsh Formation, Kansay, as “small teiid-like lizards”. Nessov (1988) claimed that the age of the Taikarshin beds is Coniacian and the Jalovatsh Formation is early Santonian. Both the assignment of these lizards to the Teiidae and the age of the beds are problematic, since the specimens are poorly preserved and the ages are
Fig. 6.—Chart showing Upper Cretaceous teiid-bearing formations (marked with "*"*) in North America and Asia.
based on sharks' teeth and brackish water molluscs, both unreliable biostratigraphically.

Mongolia: One of the largest collections of Mesozoic lizards is from the Upper Cretaceous of the central Asia Gobi Desert; since the 1920s, about 400 specimens, including skulls, jaws, and postcranial skeletons, have been collected from the Djadokhta Formation, from the Barun Goyot Formation, and from red beds in Khermeen Tsav equivalent to the Barun Goyot (see Sulimski, 1975), all of Campanian age (see, e.g., Fox, 1978; Lillegraven and McKenna, 1986). Teiid or teiid-like lizards are common in these collections. The following is a list of the Late Cretaceous teiids ( sensu Estes, 1983a) known from the Mongolian Gobi Desert:

- *Macrocephalosaurus ferrugenous* Gilmore, 1943
- *M. gilmorei* Sulimski, 1975
- *M. chulsanensis* Sulimski, 1975
- *Darchansaurus estesi* Sulimski, 1975
- *Cherminsaurus kozlowskii* Sulimski, 1975
- *Erdenetesaurus robinsonae* Sulimski, 1975
- *Adamisaurus magnidentatus* Sulimski, 1972

There is little consensus about the classification of these species at the familial level: Sulimski (1975) proposed the familial name Macrocephalosauridae to include the first four species in the list above, and used the name Polyglyphanodontidae (Gilmore, 1942) to include the next two species, plus three others from Utah (Polyglyphanodon sternbergi, Paraglyphanodon utahensis, and Paraglyphanodon gazini). Sulimski (1978) also proposed Adamisauridae for *Adamisaurus magnidentatus*, which he had earlier (1972) tentatively assigned to the family Agamidae. Estes (1983a) lowered the rank of Polyglyphanodontidae to subfamily (family Teiidae), and synonymized Macrocephalosauridae and Adamisauridae with Polyglyphanodontinae. His reasons for synonymizing these names can be summarized as: a) The twenty character states Sulimski (1975) used to separate Macrocephalosauridae and Polyglyphanodontidae as families are “almost entirely minor details of the sort generally used to separate species or genera” (Estes, 1983a:75); and, b) Sulimski’s supposed eight diagnostic characters for the Adamisauridae either overlap with those of the Polyglyphanodontinae or are primitive, leaving the Adamisauridae indefensible as a separate taxon. In Estes’ (1983a) view, *Adamisaurus* is an aberrant polyglyphanodontine. Additional specimens of *Adamisaurus* from the Upper Cretaceous of Inner Mongolia, China, are presently under study by the first author of the present paper and Prof. Hou Lianhai, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, and may provide further information about the relationships of *Adamisaurus*.

Sulimski (1984) named *Slavoia darevskii* on the basis of 46 skulls from the Barun Goyot Formation and Khermeen Tsav II, Gobi Desert. He provided no familial assignment of this lizard within the infraorder Scincomorpha, because “Slavoia is characterized by a mixture [of] characters occurring in various scincomorph families” (Sulimski, 1984:153). On the same page, however, he noted that *Slavoia darevskii* shows resemblances to some teiids and gymnophthalmids, and pointed out that a relationship with gymnophthalmids is the more likely; unfortunately, Sulimski (1984) did not specify the basis for this conclusion. Geographically, the Gymnophthalmidae ( sensu Estes, 1983a; Presch, 1983) are presently restricted to South America, and lack a fossil record from South America or elsewhere (Estes, 1983a); Presch (1980) proposed a South American origin for
the group. Thus, clarification of the relationship of Slavoia darevskii with other lizards is of importance; however, we know of no synapomorphies that might unite Slavoia with gymnophthalmids (see Estes et al., 1988:217).

**North America:** Late Cretaceous teiids from North America were first documented in the late 1800s. Marsh (1892) founded the name Chamops segnis on a fragmentary dentary (YUM 1036: this specimen is now housed in the U.S. National Museum of Natural History (Estes, 1983a)) and Iguanavus teres on several vertebrae from the “Laramie Formation” (=Lance Formation) of eastern Wyoming (the latter species name is the synonym of the former, according to Estes, 1964, 1983a). Marsh’s naming of Chamops segnis also marked the first report of Late Cretaceous terrestrial lizards from North America.

The oldest record of North American Late Cretaceous teiids is of Aquilian or early Campanian age, from the upper member of the Milk River Formation (Russell, 1964; Williams and Burke, 1964): Fox (1972) was the first to recognize lizards of this age in North America and reported six lizard species in his preliminary list of the Milk River fauna; two of the six are definitely teiids. A detailed study of these lizards is being undertaken by the first author of the present paper.

The next oldest known record of Late Cretaceous teiids is of Judithian or mid-Campanian age. In addition to those from the Oldman Formation (see above), Sahni (1972) identified Judithian Chamops segnis and Leptochamops denticulatus from the Judith River Formation, Montana, and Parris and Grandstaff (1989) cited “teiids” as occurring in the Judithian Marshalltown Formation, New Jersey, although at this writing, these have yet to be described.

Late Campanian teiids are known from the Fruitland Formation, New Mexico (Armstrong-Ziegler, 1978, 1980; Sullivan, 1981). The late Campanian age of the Fruitland Formation has been determined from pollen (Fassett and Hinds, 1971), ammonite and radiometric dating (Cobban, 1973; Fassett, 1987; Brookins and Rigby, 1987), and comparison with Lancian and Judithian vertebrates from Wyoming, Montana, and Alberta (Armstrong-Ziegler, 1980; Lucas et al., 1987; Rigby and Wolberg, 1987). Armstrong-Ziegler (1978) recorded Chamops segnis and Leptochamops denticulatus together with anguid lizards in a faunal list; taxonomic descriptions of these lizards were published subsequently (Armstrong-Ziegler, 1980). Sullivan (1981) described an incomplete right dentary (UNM FKK-038a) from the Fruitland Formation, and identified the specimen as cf. Chamops segnis.

Another teiid, probably about the same age as those from the Fruitland Formation, is from Member B of the Wapiti Formation (Dawson, 1881; Allan and Carr, 1946), Kleskun Hills, near Grande Prairie, northwestern Alberta. Sternberg (1951) identified a fragmentary lower jaw (NMC 8891) from this horizon as Chamops cf. [C.] segnis; C. segnis is a common Lancian teiid. From the illustration (Sternberg, 1951:256), NMC 8891 seems to differ from the holotype (YUM 1036) of C. segnis and from the other specimens of this species that Estes (1964) described (UCMP 49871, 46033) in having relatively high crowned and less swollen teeth, as well as having a subdental shelf that sharply decreases posteriorly; NMC 8891 also retains the splenial. The age of the Wapiti Formation ranges from Campanian to Maestrichtian (Stott, 1975), whereas Member B of the formation is probably late Campanian (or somewhat younger) in age. Recent discovery of Pachyrhinosaurus (Ceratopsidae) fossils at Pipestone Creek (northwest Alberta) suggests that part of the Wapiti Formation correlates with the Horseshoe Canyon Formation (Edmontonian) of central Alberta (Tanke, 1988; Dodson and Currie, 1990).

The latest Cretaceous teiid record is late Maestrichtian or Lancian in age, from
the Lance Formation, Wyoming (Marsh, 1892; Gilmore, 1928; Estes, 1964, 1983a); Hell Creek Formation, Montana (Estes, 1969; Estes et al., 1969); North Horn Formation, Utah (Gilmore, 1940, 1942, 1943; Clemens, 1961; Clemens et al., 1979; Lillegrauen and McKenna, 1986); and Frenchman Formation, Saskatchewan (Fox, 1989). The following is a list of Lancian teiids presently known from North America (except for Chamops cf. [C.] segnis, which may be Edmontonian in age):

- *Polyglyphanodon sternbergi* Gilmore, 1940
- *Paraglyphanodon utahensis* Gilmore, 1940
- *Paraglyphanodon gazini* Gilmore, 1943
- *Chamops segnis* Marsh, 1892
- *Chamops cf. [C.] segnis* (see Sternberg, 1951)
- *Leptochamops denticulatus* (Gilmore, 1928)
- *Meniscognathus altmani* Estes, 1964
- *Peneteius aquilonius* Estes, 1969
- *Haptosphenus placodon* Estes, 1964

All of the species listed above have been well described by previous authors, but the relationships of some are still unclear. The genus *Paraglyphanodon* is probably the closest form to *Polyglyphanodon* among Lancian teiids, as Gilmore (1943) originally recognized, although Estes (1969, 1983a) has noted that *Paraglyphanodon gazini* and *Paraglyphanodon utahensis* may be based on only young individuals of *Polyglyphanodon sternbergi*. A final decision about the validity of *Paraglyphanodon* must await a better understanding of ontogenetic changes in *Polyglyphanodon* (Estes, 1983a).

Possible relationships of *Chamops* with *Callopistes*, and *Peneteius* with Recent *Dicrodon*, *Teius*, and fossil *Paraglyphanodon* and *Polyglyphanodon*, have been discussed by Estes (1969, 1970, 1983a), as have those between *Leptochamops* and *Meniscognathus* with the Recent *Kentropyx-Cnemidophorus-Ameiva* group (Estes, 1964, 1983a). No evidence permitting more detailed interpretation has been discovered since. Estes (1983a) tentatively placed *Haptosphenus* in the subfamily *Polyglyphanodontinae* (Teiidae), but noted that this aberrant lizard may well be allocated to a different family in the future.

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