

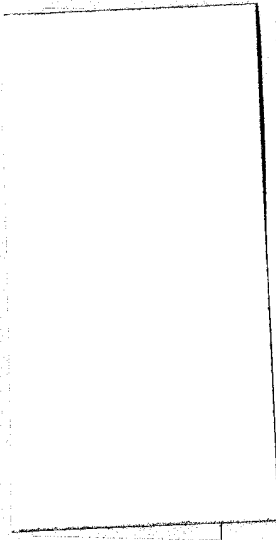
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NUMBER 44

FEBRUARY 1984

A HISTORY OF FOSSIL AMPHIBIANS AND REPTILES
IN FLORIDA

Peter A. Meylan



A Publication of the
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Florida State Museum, University of Florida
Gainesville, Florida 32611

FLORIDA PALEONTOLOGICAL SOCIETY, INC.
FLORIDA STATE MUSEUM
MINUTES OF THE 6TH ANNUAL BUSINESS MEETING
OCTOBER 1, 1983

THE PLASTER JACKET

is a publication of the
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The meeting was called to order at 11:15 AM by
President Cliff Jeremiah.

The minutes, as printed in the March 1983 issue
of the Plaster Jacket, were approved unanimously.

Howard Converse presented the Treasurer's Report
as follows:

TOTAL 1983 RECEIPTS AND EXPENDITURES

Receipts

Membership	\$ 1904.00
Sales of patches	210.00
Book fund receipts	365.00
Thomas Farm Field Camp *	4950.00
Spring Meeting Dinners	<u>1131.00</u>

Total Receipts \$ 8560.00

Expenditures

Reitz Union (coffee & donuts, fall meeting)	\$ 66.25
Donna Custom Caterers (spring meeting dinner)	1000.00
University of Florida (printing)	1500.00
Thomas Farm field camp (expenses) *	4245.05
Secretary of State (corporate report)	10.00
Spring meeting refunds	10.00
Thomas Farm cancellation refunds *	375.00
University of Florida (Cont. Educ. credits/Thomas Farm)	<u>50.00</u>

Total Expenditures \$ 7256.30

NET INCOME FOR 1983 = \$ 1303.70

CURRENT BANK BALANCE = \$ 3309.37

*see separate Thomas Farm accounting (next page)

1983 THOMAS FARM FIELD CAMP

Receipts

19 participants attending	\$ 4375.00
8 non-refundable deposits @\$25/ea	200.00

TOTAL RECEIPTS	\$ 4575.00
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Expenditures

Howard's Plumbing (plumbing supplies)	22.34
Hughes Supply (plumbing materials)	30.37
Dampier Septic Tanks (porta-johns)	200.00
Goldberg & Co. (waterproofing)	159.90
Bowman's Freight (freight charges on the above)	34.06
Live Oak Gas Co. (hot water heater)	80.00
Paul's Backhoe Service (septic tank)	450.00
Museum Associates (membership and insurance)	185.00
S. David Webb (supply reimbursement)	145.00
Richard Herring (food, supplies, and mileage)	1681.86
Zell's Hardware (supplies)	164.80
Sears (extra waterproofing)	95.94
Operating Cash (supplies, gas, etc.)	508.47
Georgia Boy's Bar-B-Q (2nd wk. barb.)	65.38
Student Assts. (Richard Hulbert & Ann Pratt)	400.00
Texgas (propane)	21.85

TOTAL EXPENDITURES	\$ 4245.05
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NET INCOME = \$ 329.95

The report was approved as presented.

Dave Webb reported on the 1983 Field Camp at Thomas Farm with a slide presentation. He urged members to participate. During the discussion that followed, there was strong sentiment for continuing this program.

Dave also presented the Editor's Report. He apologized for the delay in getting out Plaster Jacket #43. The two previous issues were recapped.

The Fund Raising Report was presented by Cliff Jeremiah. He explained that attempts to date have had limited success. There was a chance that \$5000 from the Kingfish tournament would be donated to the book fund. Ben Waller also reported regarding the scholarship fund. Two companies have promised large sums, but at present cannot donate because layoffs are occurring. A continuing effort to search out and solicit funds for FPS causes was urged on all FPS members.

There was no Old Business.

NEW BUSINESS

Bryan Ridgway requested that the Society support efforts to have Pinellas County make the Toy Town Site a geological park. Dave Webb commented that the Museum's general interest was to promote good paleontology within the State, and that the Museum's appropriate role in this case was behind the scenes, but strongly supportive. Ray Robinson, representing the Sun Coast Archaeological and Paleontological Society, advised that their organization was actively working to preserve the site. He reported that the County officials wanted to make the area a wildlife sanctuary and that including a geological park was compatible. He recommended that the concept be discussed further during the Society's Board Meeting. A request was made to keep communications open with Dave Webb at the Museum. Bryan moved that the Society favored making Toy Town a geological park. The motion was seconded and passed.

The Election Committee presented the officers for 1984 installation:

President:	Joe Larned
President-Elect:	Frank A. Garcia
Vice President:	Bessie G. Hall
Secr./Treasurer:	Howard H. Converse, Jr.
New Directors:	Gordon Hubbell Jesse S. Robertson

The meeting was adjourned at 11:50 AM.

Respectfully submitted,

Howard H. Converse, Jr.
Secretary/Treasurer

R E M I N D E R

Membership renewal notices will be mailed with this copy of the Plaster Jacket. This is just a reminder that as of 1 March 1984 the membership list will be pared down to include only members in good standing. If you have not already done so, please renew your FPS membership. Encourage a friend or two also.

N O T E

The following paper has been taken from the Florida Herpetologist, No. 5, with slight revisions and a title change.

A HISTORY OF FOSSIL AMPHIBIANS AND REPTILES IN FLORIDA

Peter A. Meylan

It won't be surprising if no ever finds a dinosaur in Florida. For if they are here, they are buried under thousands of feet of sediment. Even though we won't find evidence of these great reptiles, we do have fossils of all of the modern orders of reptiles found in Florida now: turtles, crocs, lizards, and snakes.

In three prior issues, the Plaster Jacket has dealt with fossil snakes (#3), fossil crocodilians (#5), and fossil turtles (#16). This issue reviews the history of all herp groups in Florida and traces the origins of our modern herpetofauna.

The oldest vertebrate known from Florida is a turtle which came from a well core. It was dug up from more than 9000 ft below the surface, in rocks of Cretaceous age (see Fig. 1). These remains, which come from the last part of the age of dinosaurs, are fragments of the shell, a neck vertebra, and the partial pectoral girdle of a small marine turtle. Vertebrate remains rarely occur in well cores, so it is only by accident that we know of this Cretaceous reptile. We must look to our oldest exposed rocks to discover what we can about our ancient reptiles and amphibians.

Mr. Meylan is a Biologist in the Herpetology Division, Florida State Museum. He received his Master's degree and is now a Ph.D. candidate in the Department of Zoology, University of Florida, Gainesville 32611.

EOCENE

The oldest exposed rocks in Florida are of Eocene age; that is to say, about 45 million years old, and about 20 million years younger than the end of the age of dinosaurs. They are marine limestones and, as one would expect, the vertebrates found in them are all sea creatures. Late middle Eocene rocks of the Avon Park limestone in west central Florida yielded a partial jaw of a marine crocodile and a shell fragment of a marine turtle. The late Eocene Crystal River Formation yielded a vertebra of a paleophid snake. The Paleophidae are extinct marine snakes that apparently were common in Eocene seas (see Fig. 2). They are not related to the modern sea snakes (Hydrophidae) but seem to be related to the Boidae. Paleophids reached lengths of 8 ft or more. They

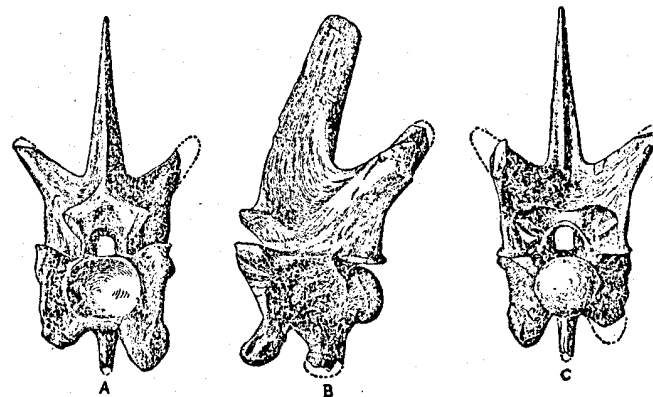


Figure 2. Vertebra of a paleophid snake *Pterosphenus*. Note the large posterolateral "wings." The vertebra is shown in frontal (A), lateral (B), and posterior (C) views. Taken from Gilmore (1938).

PERIOD	EPOCH	LAND MAMMAL AGE	ABSOLUTE AGE	FLORIDA FOSSIL SITES
Quaternary	Pleistocene	Rancholabrean		Devil's Den Sabertooth Cave Haile II Arredondo Reddick Haile VII and XII
		Irvingtonian	2 mya	Coleman II Haile XVI Ingalls IA
Tertiary	Pliocene	Blancan	5 mya	Haile XVA and IA Santa Fe IA and IB Bone Valley
		Miocene	Hemphillian	
	Clarendonian			Love Bone Bed
	Barstovian			Quincy - Midway
	Hemingfordian			Thomas Farm
	Arikarean		25 mya	Buda SBIA (Live Oak) unnamed Hillsborough County site
	Oligocene	Whitneyan	36 mya	I-75
	Eocene		54 mya	Twiggs Clay (Georgia) Crystal River Avon Park
Paleocene		65 mya		
Cretaceous				

Figure 1.

have also been found in nearby Eocene fossil sites in Mississippi, Alabama, and Georgia, and in other Cretaceous to Eocene localities throughout eastern North America, Europe, and North Africa.

The Georgia site (Twiggs Clay) containing the paleophid snake also gives us our first glimpse of what the earliest terrestrial snakes in Florida may have been like. There are two small, probably semi-fossorial, boid snakes in this fauna. Although we don't know if these snakes had the short tail and star-like tail vertebrae characteristic of modern sand boas, it has been assumed that they are related to the rough scaled sand boa and its allies, and they are thus placed in the subfamily Erycinae. The subfamily is widespread and diverse in the Tertiary of North America and, as we will see, becomes common in Florida. In this same fossil locality is a fragment of a pelobatid frog, related to our modern spadefoot toads.

OLIGOCENE

The oldest terrestrial herpetofauna, and the first of any size, is from late Oligocene, about 25 million years old. The site was discovered in Gainesville during construction of Interstate Highway 75, and the name "I-75" has been given to it. The fauna includes many forms that are now extinct, revealing that during the mid-Tertiary our herpetofauna was vastly different from what it is today. Perhaps the most apparent difference is the large proportion of lizards relative to snakes. There appear to be as many kinds of lizards as snakes, unlike today, when there are twice as many snakes as lizards. The lizards include members of at least three, and possibly four families. The Anguidae (glass lizards and their allies) are represented by a jaw and a piece of dermal armor that might belong to a limbed form called Peltosaurus. The limbless Ophisaurus may be represented by a single vertebra. The teeth of

iguanid lizards are easily recognized by their multiple cusps. Two iguanid jaws found in the I-75 site may represent Aciprion, a genus that is known from other Oligocene fossil localities in the American West. The lizard family Xantusidae (night lizards) is represented by a jaw of the extinct genus Paleoxantusia. One vertebra preserved with the rest of this material may be that of a teiid lizard.

Most of the snakes are of the erycine type, with perhaps three or four species present. A worm snake, Typhlops, may also be represented. Most interesting among the snake fossils is a single vertebra of a small racing colubrid. It is the oldest known colubrid in the New World.

There are scraps of two different turtles at the I-75 site. One is a tortoise, probably of the extinct genus Floridemys, which may be distantly related to Gopherus. The other may be an early emydid, such as Pseudemys.

There are also three families of frogs present: the Ranidae (true frogs), the Bufonidae (toads), and the Pelobatidae (spadefoot toads).

Studies of the material from the I-75 site are not complete, but we can already see that its herpetofauna is quite different from the modern one. It is remarkable that erycine boids once made up the majority of our snake fauna and, as we will see, did so for many more millions of years. The lizards included a member of the Xantusidae, a family now restricted to western North America and Central America. Fossil xantusids have been found in places like Montana and South Dakota, and so, it seems that their current distribution may be a relictual one. Lizard buffs will know that one xantusid now lives on Cuba. We might wonder if this fossil from the Oligocene of Florida has anything to do with the occurrence of Cricosaura on Cuba.

One might not think of the Anguidae (glass and alligator lizards) as being a major part of the lizard fauna of North America. Today, we have only

two genera (Ophisaurus and Gerrhonotus) in North America. During the Tertiary, however, there were many more genera, and they were found over much of the continent. The extended range of limbed anguids is evident in I-75, with the occurrence of "Peltosaurus." We will see that there were other limbed anguids in the Miocene of Florida.

EARLY MIOCENE

The Miocene is a long epoch, lasting more than 20 million years. During this period the herpetofauna changes from one that includes many genera, and even families, no longer found here, to one that is made up almost entirely of genera that occur in Florida today. The five land mammal ages of the Miocene (Fig. 1) will be used as guideposts in this long epoch. We here group the first two of these ages as early Miocene.

The oldest of the five Miocene land mammal ages is the Arikareean. Four sites from this age have been identified in Florida. Only three of these have reptiles and/or amphibians in their faunas. An unnamed site in Hillsborough County, Buda, and SB 1A (Live Oak) contain large herpetofaunas. All three have erycine boids, probably of the extinct genera Calamagras and Ogmophis; and all three have a limbed anguid lizard of fairly good size which may be related to the "Peltosaurus" in I-75. The unnamed Hillsborough fauna also contains what may be the oldest anilid snakes from Florida. The Anilidae is now a rare family, with only two genera remaining, Anilius in South America and Cylindrophis in Southeast Asia, but their fossil record indicates that they were more widespread in the past. This same fauna also includes a tortoise that seems to be an early type of Gopherus, and a frog that has not yet been allocated, even to family.

In addition to its anguid and its erycine boids, Buda also includes the earliest boine boid from

Florida (Pseudoepicrates), the earliest box turtle (Terrapene), tortoise (Geochelone), and an iguanid lizard. SB 1A contains the earliest rhineurid amphisbaenian known from Florida, a pelobatid frog, and a kinosternid turtle.

These faunas do not differ markedly from I-75. A few new forms are added, but this may be due to differences in the habitats sampled. It is important to note that there are no colubrid snakes in these faunas. We know from the specimen in I-75 that colubrids are present, but they apparently are still a minor part of the snake fauna. This is soon to change. As we shall see, the colubrids will become dominant, replacing the boids completely by the late Miocene.

The Hemingfordian age is represented by a large and very diverse fauna of at least 25 genera of reptiles and amphibians. This fauna is from the famous Thomas Farm locality. The snakes from Thomas Farm show the beginnings of the trend mentioned above. There are four boid snakes and two colubrid snakes. The boids include Pseudoepicrates, a large form presumably related to the extant tree boas (Epicrates); two erycine boids, Ogmophis and Calamagras; and a small snake named Aniliodes. This genus was originally thought to belong in the Anilidae, but has been placed in the Erycinae by some authors. The two colubrids are called Pseudocemophora and Paraoxybelis. As their names suggest, these snakes are considered to be similar to extant genera. The former is similar to the scarlet snake (Cemophora) and the latter to the vine snakes (Oxybelis). The former is certainly a constricting type of snake, while the latter is a racer.

The lizards include the earliest skink (Eumeces) and the earliest gekkonid (an unidentified genus) from Florida, as well as a Gila monster (Heloderma). The iguanids are very diverse, with as many as four genera present. A curly-tailed lizard (Leiocephalus) has been reported from Thomas Farm. One of the other

iguanids seems to be an Anolis, or at least is related to anoles. A third form is an iguanine, one of the larger herbivorous group of iguanids that includes Iguana, Ctenosaura, and Cyclura. The Teiidae is represented by a form that has so far been referred to Cnemidophorus. This is the only record for Cnemidophorus in Florida until the middle Pleistocene. As in the older fossil faunas discussed above, Thomas Farm includes a moderately large, limbed anguid. It was originally described as Peltosaurus floridanus, but it is now suspected that the type specimen was actually from another fossil deposit in the western United States, and was accidentally mixed in with Thomas Farm fossils.

Other reptiles include a tortoise (Geochelone) that is no longer found living in North America, a cooter (Pseudemys) that is probably related to the redbellied turtles, a chicken turtle (Deirochelys), and an extinct species of Alligator.

Amphibians are also well represented at the Thomas Farm locality. Salamanders include the highly aquatic genera Siren and Notophthalmus (the newt). There is also a salamander that belongs to an extinct family, the Batrachosauroididae. Batrachosauroides was large, up to 3 ft, and elongate. It probably had a life style similar to that of Amphiuma.

The frog fauna from Thomas Farm is quite remarkable. All five of the frog families native to Florida today, plus the Leptodactylidae, are present. No fewer than 9 genera and 13 species have been recognized. Of these, one genus and eight species are now extinct. The most widely represented family is the Hylidae. It includes the now extinct genus Proacris, which is thought to be a possible ancestor to our cricket frogs. Cricket frogs themselves (Acris) are also represented. The tree frogs, Hyla, include three species, none of which has survived to the present. The toads (Bufo) and the leptodactylids are also extinct, as are two of three true frogs (Rana). The leopard frog (Rana pipiens), the

spadefoot toad (Scaphiopus holbrooki), and the narrowmouth toad (Gastrophryne carolinensis) have all been tentatively identified from Thomas Farm. If correct, this suggests that these frog species have lived in Florida for 20 million years.

The amphibian fauna of Thomas Farm is comparable to the modern fauna at the generic (and even partly at the specific) level; that is, the fauna contains nearly all modern genera. But the Thomas Farm reptiles are not as modern and resemble modern Florida reptiles only at the family level (the genera are different). Obviously, the reptiles must have undergone more changes since the Miocene than have the amphibians. A large part of this difference in the reptiles has been attributed to a West Indian influence in the Miocene of Florida. The snake Pseudoepicrates is thought to be similar to the West Indian boa, Epicrates. The curly-tailed lizard (Leiocephalus) is also common throughout the West Indies. Large Iguana-like iguanids, Anolis-like iguanids, and gekkonids are present throughout tropical America, but are closest to Florida in the West Indies. The same is true of Leptodactylus and Eleutherodactylus. The presence of these forms suggests that during the Miocene some members of the West Indian fauna were able to reach Florida. If this is indeed the case, it is the most important influx from our island neighbors, at least up until the last hundred years. Another interpretation is that these genera may have occurred throughout the southeastern United States and Central America in the Miocene and are now left only as relicts in the West Indies.

The Thomas Farm fauna is the end of the line for many reptile genera in Florida. None of the snakes is known from later sites. Thus we have seen the end of the Boidae in Florida, although the family remained in Texas for about 15 million years longer and still survives today on the West Coast of North America. There are no more limbed anguids. Geckos did not appear again until they were reintroduced to

the state by humans. Leiocephalus and the iguanine also disappeared. Thomas Farm offers the first view of a fairly modern amphibian fauna, and the last record of a very different, ancient reptile fauna.

There is one interesting and enigmatic tortoise that is probably of Miocene age. It is interesting because of its small size and possible relationships. It is enigmatic because we don't really know how old it is. This is the monotypic genus Floridemys. It is still known from only a single shell collected early this century. It is a dwarf species, the type being an adult female only 105 mm long (about 8 inches). It was collected in the Holder Phosphate Mine in Citrus County. There is no other fossil basis for determining the age of these local phosphate deposits; they have no special geological connection with the Bone Valley of younger age. Floridemys may be from the early Miocene and appears to be related to the extinct tortoises of the genus Stylemys, which, in turn, is closely related to Gopherus.

LATE MIOCENE

Unfortunately the middle Miocene, or Barstovian age, is not well represented in the fossil record of Florida. Major changes occur between the Thomas Farm fauna and the next large herpetofauna from the Love Bone Bed, some 8 million years younger. The only intervening fauna, the Quincy-Midway fauna from the Florida Panhandle, is very small, with only two turtles and an unidentified crocodylian represented. It is important, however, because one of the turtles is the oldest soft-shelled turtle (Trionyx) known from the state.

The Love Bone Bed is an immensely rich fossil deposit near Archer, Florida. It can be dated to the very late Clarendonian, or about 10 mya. It has only recently been excavated, and many of the reptiles and amphibians remain unstudied. The Florida State

Museum staff has identified 12 families and 20 genera of herps to date, and many more will undoubtedly be discovered as the material is carefully examined. The fauna is strikingly modern; only four genera are no longer part of our herpetofauna. The narrow-snouted crocodile, Gavialosuchus (see Fig. 3), appears for the first time in Florida. The extinct snake Dryinoides, which is related to hognose snakes, is tentatively identified from the fauna. Two genera that arrived in Florida before the late Miocene, but are no longer part of our fauna, are Geochelone (a land tortoise) and Typhlops (a blind snake).

There are probably two different species of land tortoise in the Love Bone Bed, a situation common in Florida from the late Miocene to the late Pleistocene. The other turtles, which are modern at the generic level but different at the species level, include a soft-shell (Trionyx), a river cooter (Pseudemys), a chicken turtle (Deirochelys), and a box turtle (Terrapene).

Except for Typhlops, the snakes are all of the advanced superfamily Colubroidea. The nonpoisonous species are dominated by hognose snakes and their allies (the Xenodontinae). There are two different Heterodon species, Dryinoides, and a xenodontine that has not yet been identified to genus. The most abundant snakes are garter snakes (Thamnophis), crayfish-eating snakes (Regina), and water snakes (Nerodia). Constrictors, like king snakes (Lampropeltis) and rat snakes (Elaphe), are rare. The vipers from the Love Bone Bed are the oldest in Florida. There are at least two kinds: the larger a rattlesnake (Crotalus) or cottonmouth (Agkistrodon) and the smaller probably a pygmy rattlesnake (Sistrurus).

Lizards are rather rare in the Love Bone Bed, but at least one species of skink and a glass lizard are present. In addition to the narrow-snouted crocodile, there is also an Alligator in the fauna.

Amphibians are quite abundant. Siren is extremely common and is the only salamander identified to

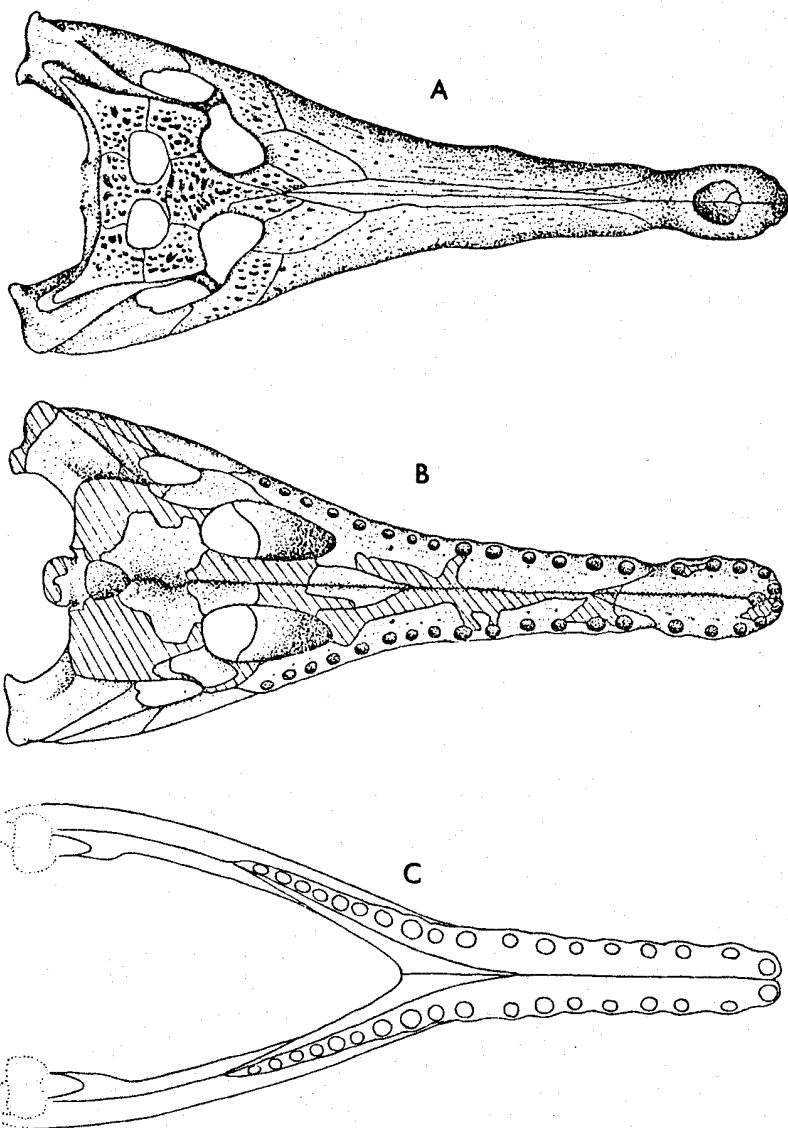
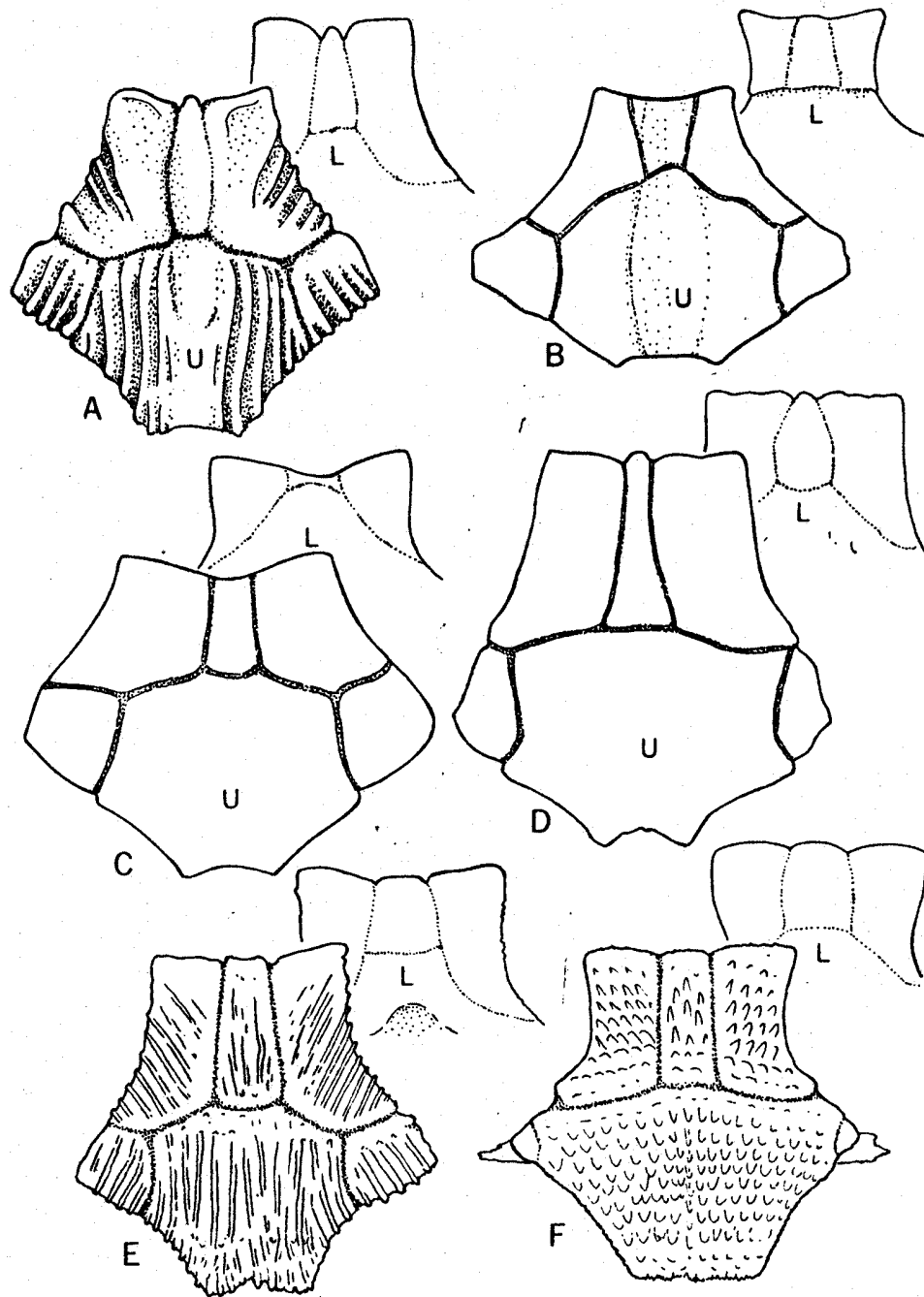


Figure 3. The skull of the extinct crocodile Gavialosuchus americanus from Haile VB near Newberry, Florida. Dorsal (A) and ventral (B) views of the skull and dorsal view of the lower jaw (C) are shown. Taken from Auffenberg 1954.

date. Frogs include ranids (true frogs), hylids (tree frogs), and bufonids (toads).

The biggest difference between the Thomas Farm and Love Site herpetofaunas is the disappearance of all boids. Boids disappeared from herpetofaunas of the United States (except on the West Coast) during the late Tertiary, but their extinction seems to have occurred very early here in Florida. Another difference between the faunas is that the lizards of the Love Site, so far as we know them, also belong to modern genera.

We have seen that our modern amphibian fauna was well established at the generic level by the early Miocene. Evidence from the Love Site suggests that many of our modern reptile genera became established here in Florida by the late Miocene. Data from several faunas that are only slightly younger than the Love Site support this conclusion. The McGehee Farm fauna includes representatives of some of our most common snake genera: Thamnophis, Coluber, Lampropeltis, Crotalus, and Elaphe. There is also a large skink that is similar to the broad-headed skink (Eumeces laticeps). There are at least six kinds of turtles, including an abundance of the extinct alligator snapper (Macrochelys auffenbergi) and two extinct species of Pseudemys. One of the Pseudemys is thought to belong to the scripta group (red-eared and yellow-bellied sliders), while the other shows affinities to the nelsoni group (red-bellied turtles) (see Fig. 4 for useful nuchal bone characters of living emydid turtles). The extinct chicken turtle (Deirochelys carri) is the same species that occurs in the Love Site. There are also remains of two sizes of tortoises (Geochelone), mud turtles (Kinosternon), and soft-shells (Trionyx) from this locality. Crocodylians include both an Alligator and the extinct narrow-snouted crocodile Gavialosuchus. The only amphibians that have been identified from the McGehee Farm so far are a siren and a toad.



Two localities near Haile, Florida (Haile VI and Haile XIX), have faunas equivalent in age to the McGehee Farm fauna. The fauna from Haile VI includes three extinct snakes, which are assigned to living genera: a hognose snake (Heterodon brevis), a short-tailed snake (Stilosoma vetustum), and a ringneck snake (Diadophis elinorae). These represent first occurrences of Stilosoma and Diadophis in Florida. Another snake appearing for the first time in Florida is the coral snake (Micrurus). Water snakes (Nerodia) and either diamondback rattlesnakes or cottonmouths are also present. Other reptiles include a small iguanid (probably Anolis) two turtles (Geochelone sp. and Deirochelys carri), and both an Alligator and a crocodile (Gavialosuchus). Amphibians include the earliest plethodontid salamander and the earliest dwarf siren (Pseudobranchius). The latter is an extinct species known only from this locality. Other amphibians are an extinct species of toad (Bufo tihenii), an extinct species of siren (Siren simpsoni), a newt, and a true frog that is probably a leopard frog.

At Haile XIX only larger reptiles have been found thus far. These include the same crocodylians and turtles as in Haile VI, plus a soft-shell turtle, a scripta-group Pseudemys, and what is possibly a Malaclemmys (diamond-back terrapin).

Withlacoochee 4A is only slightly younger than McGehee and has a similar fauna. The snakes found there are nearly the same, as are the turtles. Withlacoochee 4A turtles not found at McGehee include a box turtle (Terrapene) and some material that may represent the genus Clemmys. The amphibians include

Figure 4 (previous page). Nuchal bones are often the most useful of all shell bones in separating fossil emydid turtles. (A) Chrysemys scripta, (B) Terrapene carolina, (C) Chrysemys concinna, (D) Chrysemys floridana, (E) Chrysemys nelsoni, (F) Deirochelys reticulata. U=upper and L=lower surfaces of nuchals.

the oldest Amphiuma known from Florida and Siren, a newt (Notophthalmus), and a true frog (Rana). There are some Pleistocene fossils mixed in with this mostly Miocene fauna, so all of these records must be treated with caution.

The Bone Valley is a name applied to west central Florida's phosphate deposits. These deposits are of late Miocene to earliest Pliocene age and contain many vertebrate fossils. Few very small specimens (microfossils) come from the Bone Valley. Most of what has been collected there has survived mining operations and, therefore, is stout and reasonably large. Turtles and crocodylians make up the known herpetofauna from the Bone Valley. The turtles are all genera that occur in the McGehee, Haile VI, Haile XIX, or Withlacoochee 4A localities, with the exception of sea turtles (Cheloniidae) and gopher tortoises (Gopherus). Two crocodylians (Alligator and Gavialosuchus) are found in the Bone Valley.

As has already been suggested, the herpetofauna of Florida was essentially modern at the generic level by the end of the Miocene. All of the Hemphillian sites discussed above contain, almost exclusively, living genera. The two genera that stand out as no longer being part of our herpetofauna are the land tortoises Geochelone and the crocodile Gavialosuchus. The land tortoises survived up to the very end of the Pleistocene, but the crocodile occurred for the last time in the Bone Valley.

Gavialosuchus is an interesting crocodile for several reasons. The entire genus is now extinct. The species that occurred in Florida was Gavialosuchus americanus (Fig. 3), which was probably a marine or at least an estuarine fish-eater. Like the gavial (from which it gets its name), the false gavial, and some species of crocodiles, it had a long, slender snout that it could move through the water very quickly. This is a well known adaptation for catching fish. It was large, probably reaching lengths of more than 20 feet.

PLIOCENE

The Pliocene Epoch contains the latest Hemphillian and entire Blancan land mammal ages. This epoch is not well represented in Florida; only four sites (Haile IA, Haile XV, Santa Fe IA, and Santa Fe IB) have fossils of Blancan age, and of these, one also has late Pleistocene (Rancholabrean) fossils. However, all but one of the herps found in this site are also found in one of the other Blancan localities, so the possibility that late Pleistocene fossils will obscure the appearance of the Blancan herpetofauna seems slim. The one taxon found at the mixed locality, but not at any of the other three sites, is a map turtle (Graptemys). The describer of this material felt certain that at least some of it was of Blancan age.

Unlike most of the Blancan material, this map turtle has been studied in sufficient detail so it can be said with some confidence that it is Barbour's map turtle (Graptemys barbouri). The rest of our Blancan herpetofauna, with a few exceptions, has only been identified to genus. All of the genera are extant except Geochelone. Snakes include Drymarchon, Coluber, Masticophis, Heterodon, Farancia, Elaphe, Lampropeltis, Thamnophis, Nerodia, Regina, Agkistrodon, and Crotalus (see Fig. 5 for examples of two of these genera). Some of the Lampropeltis material definitely represents the king snake (L. getulus), some of the Elaphe material is from a corn snake E. guttata). Most interesting are the Nerodia fossils, which apparently include all four of our modern water snake species. The green (N. cyclopion), brown (N. taxispilota), red-bellied (N. erythrogaster), and banded (N. fasciata) water snakes are all present in Haile IA and/or Haile XV. No lizards have been identified from any of these faunas.

With one exception (Clemmys), all of our modern freshwater turtle genera are known from the Blancan. Chelydra, Sternotherus, and Graptemys appear for the

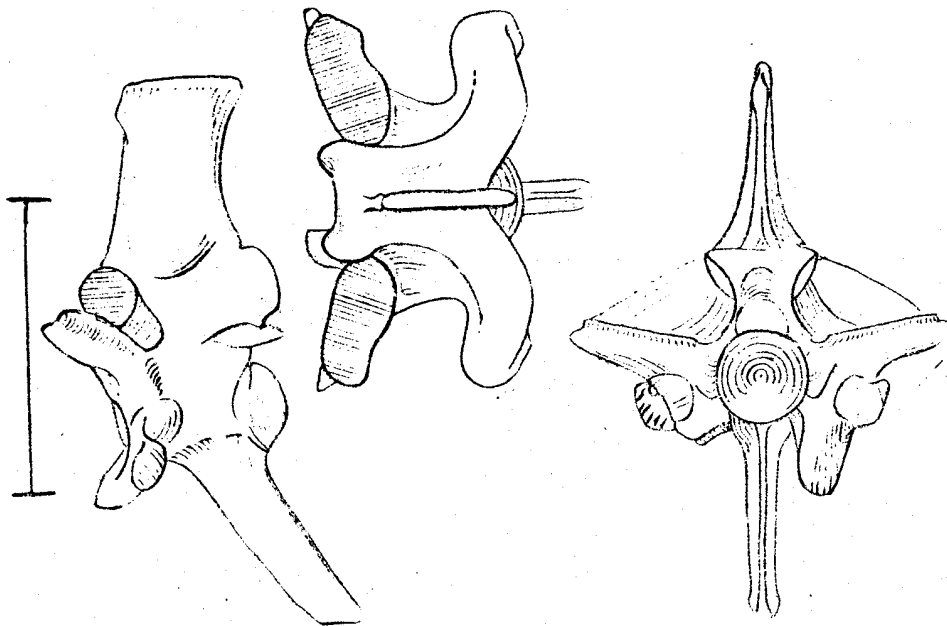
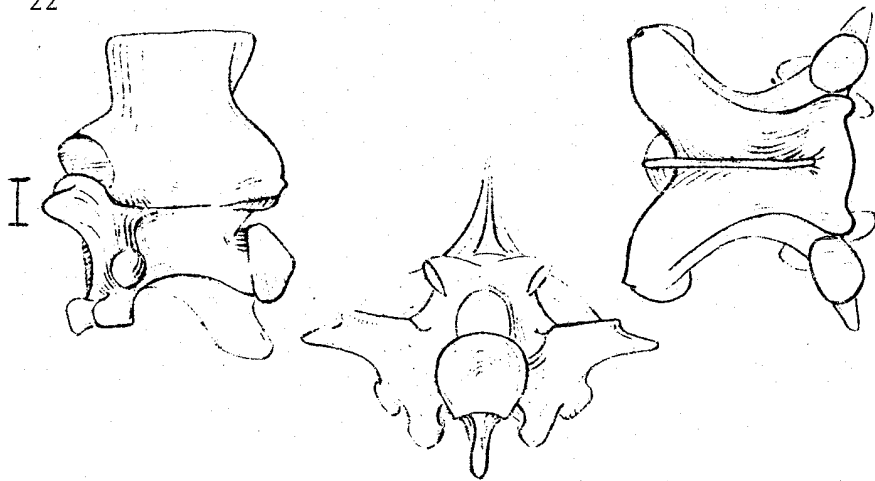


Figure 5. Vertical bars represent actual height of each vertebra. (A) Natrix sipedon (common water snake), (B) Crotalus adamanteus (eastern diamond-back rattlesnake).

first time. Pseudemys is as diverse as it is today with four species present. The modern species P. nelsoni, P. concinna, and P. scripta, as well as the extinct P. platymarginata, are all found in Santa Fe IA. Terrapene, Trionyx, Kinosternon, Macrochlemmys, and Deirochelys are also present. The Kinosternon is very likely the striped mud turtle (K. bauri).

With the extinction of Gavialosuchus at the end of the Hemphillian, Alligator is left as the reigning crocodylian. The American crocodile (Crocodylus acutus) is unknown as a fossil in Florida (see Fig. 6 for characters which will separate the skulls of Alligator and Crocodylus).

PLEISTOCENE

The final epoch in our prehistory is the Pleistocene. It began 2 million years ago and ended about 10,000 years ago. The Pleistocene herpetofauna of Florida is remarkably similar to the modern one. In fact, it would probably be easier to make a list of the species that are missing than to make a list of what is present. Two land-mammal ages fall in the Pleistocene, and we will look at them separately so we can observe the final adjustments in the herpetofauna.

The Inglis IA fauna is of earliest Irvingtonian age and is perhaps the richest and most completely studied fossil herpetofauna from Florida. With very few exceptions, the specimens in this fauna can be assigned to Recent genera and species. Only Dryinoides, a xenodontine snake tentatively identified from Inglis, is now extinct. The tortoises of the genus Geochelone are, of course, extinct in North America, but they do occur throughout much of the rest of the world. There are also extinct species of skink (Eumeces), ringneck snake (Diadophis), and crayfish-eating snake (Regina).

The Regina is one of the most interesting forms, because it is intermediate between the advanced and

primitive living members of the genus. The primitive forms (R. grahami and R. septemvittata) have slender, sharp teeth which are fixed firmly in the jaw. They can only eat newly molted (soft-bodied) crayfish. The advanced forms (R. alleni and R. rigida) have short, blunt teeth which are attached to the jaw by a hinge. The special teeth and special behavior allow these snakes to eat hard-shelled crayfish. In the Inglis form (Regina intermedia) the teeth are blunt and short but not yet hinged.

Other interesting snakes include the smooth green snake (Opheodrys vernalis), the western hognose snake (Heterodon nasicus), and an indigo snake that is more similar to the Mexican and Central American Drymarchon corais than to Florida's D. c. couperi. These three snakes and what is possibly an alligator lizard (Gerrhonotus) suggest that there was a greater affinity between western herpetofaunas and Florida's reptiles in the early Irvingtonian than exists today. It has been suggested that populations of western hognose snakes became isolated in Florida during the Pleistocene and gave rise to the southern hognose, H. simus. The smooth green snake is now found only as close to Florida as Houston, Texas, and northern North Carolina. The rough green snake has apparently replaced the smooth green snake through much of its former range.

The remaining snakes (21 species) are a good cross section of our Recent fauna. They include every species that one would expect to find in a xeric setting in peninsular Florida today. Species that occur for the first time in Florida at Inglis are: Cemophora coccinea, Lampropeltis triangulum, Pituophis melanoleucus, Stilosoma extenuatum, Rhadinea flavilata, and Tantilla sp.

The amphisbaenian, Rhineura floridana, and four lizards complete the squamates from Inglis. In addition to the Eumeces and Gerrhonotus mentioned above, the lizards include the most common of our modern glass lizards, Ophisaurus ventralis, and the fence lizard Sceloporus undulatus.

The turtles from Inglis include four terrestrial forms and three aquatic forms. There are both a large and a small species of Geochelone, a box turtle, and many specimens of a gopher tortoise. The aquatic forms are a soft-shell turtle, a snapper, and a slider (Chrysemys scripta). There are also a few specimens of Alligator in this fauna.

The two tortoises from Inglis represent two subgenera of the genus Geochelone. The smaller one, Geochelone incisa, is a member of the subgenus Hesperotestudo. It can be recognized by its unique caudal buckler, a scale-covered trap door that covers the dorsal surface of the tail and protects the posterior end of the animal (Fig. 6). The larger Inglis tortoise, Geochelone crassiscuttata, belongs to the subgenus Caudochelys. Members of this subgenus had unmodified tails, and they grew to a much greater size than Hesperotestudo. G. crassiscuttata is as large as, or larger than, the Galapagos tortoise. Both these subgenera can be traced back to the Oligocene. Caudochelys is probably represented by G. tedwhitei from Thomas Farm and by G. hayi from the Bone Valley. There are also one large and one small tortoise species at McGehee and at the Love Bone Bed. They may be representatives of these same two long-persisting lineages.

The amphibians of Inglis IA are less numerous than the reptiles, both in terms of numbers of species and numbers of individuals. The frogs are largely xeric-adapted species, as are the snakes and lizards. By far the most common is an undescribed toad with very large cranial crests. Other xeric-adapted forms are the spadefoot toad (Scaphiopus) and the gopher frog (Rana areolata). There are also a few narrowmouth toads (Gastrophryne), bullfrogs (Rana catesbiana), and a green tree frog (Hyla cinerea). As one would expect in a xeric setting, there are few salamanders. The few known specimens belong to one or two species of mole salamander (Ambystoma).

When a fossil herpetofauna is examined in detail, as the Inglis IA fauna has been, it becomes apparent

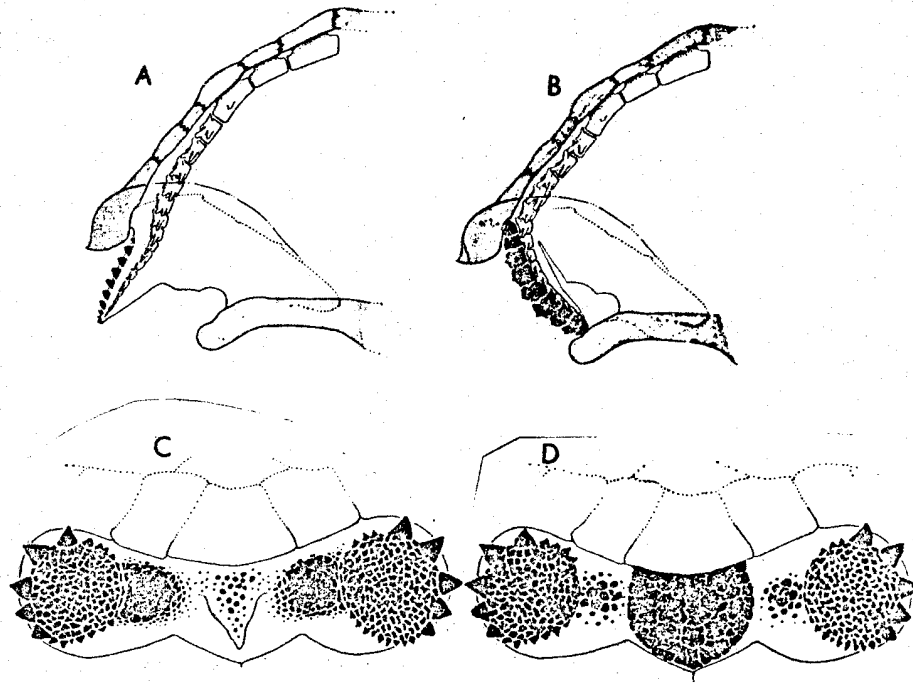


Figure 6. Two lineages of fossil tortoises from Florida. Caudochelys (A and C) has a tail much like that of other turtles and tortoises. The dermal armor on the tail does not form a continuous plate. Hesperotestudo (B and D) has a "caudal buckler" formed by fusion of the dermal armor on the tail. This results in a large shield that covers the tail and vent. A and B are cross-sections through the posterior half of the shell at the midline. C and D are posterior views. Taken from Auffenberg (1963).

that the ecological setting of a fossil fauna is an important factor in species composition. Thus, two fossil localities of the same age may have entirely different herpetofaunas only because they accumulated in different environments. The xeric setting found at Inglis appears to have been widespread during the early Pleistocene. The fauna accumulated in a sink-hole in a savanna that apparently extended around much of the Gulf of Mexico. This savanna may have provided an avenue for the arrival of some xeric-adapted species which did not occur in Florida until post-Inglis time. Some examples would be Cnemidophorus sexlineatus, Ophisaurus attenuatus, and Opheodrys aestivus.

Haile XVIIA and Coleman IIA occur later in the Irvingtonian than Inglis but have faunas that are remarkably similar to that of Inglis IA. The Haile site contains at least four species not found at Inglis. The presence of three of these, Notophthalmus, Kinosternon, and Deirochelys, can be attributed to a slightly more mesic setting. The presence of Cnemidophorus is more interesting as it is the first occurrence of this genus in Florida since the early Miocene. Coleman IIA contains five species that do not occur at Inglis. The lizards Eumeces inexpectatus and Anolis carolinensis and the snakes Carphophis amoenus and Heterodon simus appear for the first time.

The Rancholabrean is the "yesterday" in our fossil record. Herpetologically, it lasted until about 8 thousand years ago. It was only then that the last of the Geochelone disappeared from Florida. Evidence of this can be found at Devil's Den Sinkhole in Levy County, Florida, where both G. incisa and G. crassicutata occur. There are both tortoise and human remains fossilized in this water-filled sinkhole and also in Little Salt Springs in Charlotte County. This and other evidence suggest that the earliest people to arrive in Florida found giant tortoises (Geochelone) living here, and that these paleo-

Indians may have hunted them. If so, they were at least partially responsible for the disappearance of these and possibly other large Pleistocene vertebrates.

Two species of amphibians also became extinct by the end of the Pleistocene. Both are small species, however, and it seems unlikely that the early Indians were responsible for their disappearance. Hyla baderi is a small treefrog known only from the Rancholabrean Arredondo locality. An extinct dwarf siren, Pseudobranchius robustus, is known from three fossil localities--Arredondo, Reddick, and Haile VII.

Some species appear for the first time in the fossil record of Florida during the Rancholabrean. Among these are Ophisaurus compressus at Haile II; Eumeces cf. fasciatus at Reddick IB, Bufo woodhousei at Devil's Den; Hyla femoralis, H. gratiosa, H. squirella, and Rana grylio at Haile XIB; Pseudacris ornata and Necturus sp. at Arredondo; Plethodon glutinosus at Sabertooth Cave; and Carphophis amoneus at five different localities.

Most interesting among these are the species that occur as fossils well to the south of their modern distribution. The movement of more tropical species northward (Geochelone) and more temperate species southward (Carphophis and Necturus) during previous periods of the Pleistocene is attributed to glacial climates. South of the ice, the extremes of cold in winter and heat in summer that we know now were ameliorated then. Thus cooler summers permitted the existence of forms now widely separated to the north and warmer winters the forms now more tropical.

It has long been suggested that the isolation of various herps in peninsular Florida during glacial advances was a major factor in the evolution of our herpetofauna. However, we can see from this review that most of our herpetofauna was well in place before the Pleistocene. Much of the modern fauna was in place during the Miocene, the amphibian genera by early Miocene (20 mya) and the reptilian genera by late Miocene (10 mya).

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