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Annual Dues--Members	$ 6.00
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Single Issues Nos. 30-Present	$ 2.00

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THE PLASTER JACKET
Florida Paleontological Society, Inc.
Florida State Museum
University of Florida
Gainesville FL 32611

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THE PLASTER JACKET

NUMBER 39 MARCH 1982

FOSSIL CAMELS OF THE GULF COASTAL PLAIN

S. David Webb

A Publication of the
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Florida State Museum, University of Florida
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O F F I C I A L B U S I N E S S

FLORIDA PALEONTOLOGICAL SOCIETY, INC.

Minutes of the Fourth Annual Business Meeting
10 October 1981

The meeting was called to order at 11:15 AM by President Ben Waller, who presented a brief opening talk.

The minutes were accepted as printed in the January 1981 issue of the Plaster Jacket.

Howard Converse presented the Secretary-Treasurer's Report. The current bank balance is $515.95. Expenses for the year included: $1000, University of Florida Printing Blanket; $19, Spring Meeting Expenses; $32.32, Miscellaneous printing expenses; $1009.18, E.O. Painter Company for printing the Plaster Jacket; $10, Corporation Report to Secretary of State. Total expenses: $2070.50. The report was approved, seconded, and unanimously voted upon by the members present.

The Editor's Report was presented by David Webb. It was reported that the Society was trying to keep up the quality of the Plaster Jacket and to publish a minimum of three issues per year. A short recap of the past three issues was given. The Plaster Jacket is the primary means of projecting information to the membership. Dave Webb requested papers from the members. It was stated that the membership roster was printed this year at the members' request.

David Webb reported on the Thomas Farm Field Camp. He stated that it was discouraging for the committee to have gone through all of the planning and then have it fall through. Nonetheless, we can learn from our failures and persevere. The Board of Directors at its Spring Meeting urged another effort. A new brochure has

been printed for distribution at this meeting. Extension credits totalling 4.6 units will be granted instead of the 3 printed in the brochure.

Clifford Jeremiah gave the Historian's Report. He requested stories from the membership about the members and other Florida collectors.

The Ethics Committee Report was presented by Ben Waller. The proposed By-Law amendments recommended by the Ethics Committee differed from those published in Plaster Jacket No. 38 as follows:

ARTICLE II Membership

Section 1. . . .

Section 2. . . .

Sections 3, 4, and 5. (Delete those proposed in the PJ #38.)

Section 6. (New, would now become Section 3.) The Board of Directors, by affirmative vote of two-thirds of its members, may, after an appropriate hearing, suspend or expel a Member or Associate Member for cause. "Cause" is here defined as open and notorious conduct which may be associated in the mind of the public with the Florida Paleontological Society and which can reasonably be expected to injure the reputation of the Society.

ARTICLE IX Code of Ethics (New)

Section 1. A Member of the Florida Paleontological Society is expected to strive to increase his own knowledge of paleontology, particularly of Florida prehistory.

Section 2. A Member is expected to share his knowledge with fellow members and with the public to encourage the study of paleontology.

Section 3. A Member is expected to share significant information with professional paleontologists so that important data is not lost to science.

Section 4. A Member is expected to make fossil material available for examination, under reasonable terms and conditions, by professional and non-professional members in order to further the study of paleontology.

Section 5. A Member who is a professional paleontologist is expected to deal with non-professional members in a helpful, supportive manner.

Section 6. A Member is expected to be sensitive to ecological concerns when doing field work.

Section 7. A Member is expected to conduct his paleontological activities in such a manner that the Florida Paleontological Society will not be brought into disrepute.

A motion was asked from the floor. The motion was made to accept Article II as read and was seconded. A brief discussion followed. The motion was carried. A second motion was made to accept Article IX with the seven sections as read and was seconded. Discussion followed. The motion was passed as read.

Ray Robinson gave the By-Laws Committee Report. He reviewed the results of the questionnaire concerning the establishment of chapters that had been sent to the membership. Most members were in favor of establishing chapters. A motion was made and seconded to add the following section to the Constitution:

ARTICLE III Membership

Section 3. Chapters of the Society.

1. Status as a chapter of the Florida Paleontological Society is open to any group of at least ten persons who:
   a. As individuals meet the qualifications for membership in the Society.

b. Band together for establishment of a local (city, county, or area) organization to pursue the objectives of the Society, as well as for the purpose of their own, so long as such purposes are not contrary to the Constitution of the Society.
c. Request formal recognition by the Society as a chapter.
d. Adopt a Constitution and By-Laws (not in conflict with the Society's Constitution and By-Laws) to provide efficient operaton of the chapter.
e. Agree that all members of the chapter shall maintain membership in the Florida Paleontological Society.

2. Application for chapter status shall be made by the interested group to the Board of Directors of the Society. Upon majority vote of approval, the Board of Directors shall instruct the Secretary to issue formal recognition to the chapter.

Discussion followed with Ray Robinson stressing his feelings on the importance of chapters. The motion was amended by Bessie Hall and seconded to read: (e) All chapter members must be members of the Florida Paleontological Society (incorporated in Section 3.1e above). The motion was carried as amended. David Webb moved that all other proposed By-Law and Constitution amendments printed in P.J. #38 be approved, and this motion was seconded and carried.

David Webb, representing the Nominating Committee, presented the names of the newly elected officers in the Society, as follows:

President-Elect	Clifford Jeremiah
Vice President	Thomas C. Watson
Board of Directors	Guy Selander, Jacksonville Ray C. Robinson, St. Petersburg William Brayfield, El Jobean
Secretary-Treasurer	Howard H. Converse, Jr.

President Ben Waller gave a retirement speech to the membership and adjourned the meeting at 12:45 PM.

Respectively submitted,

Howard H. Converse, Jr.
Secretary-Treasurer

1982 Committee Appointments

Editor: S. David Webb

Nominating Committee (consisting of President and Past President):
Ben Waller, Chairman
Bruce J. MacFadden
Gary Morgan

Scholarship Award Fund Coordinator (new, see below): Ben Waller

Book Fund Coordinator (new, see below):
Clifford Jeremiah

1982 Spring Meeting Coordinator:
Joe Larned

Thomas Farm 1982 Field Program:
Ed Brown, Chairman
Howard H. Converse
Bruce J. MacFadden
S. David Webb

FPS LAUNCHES FUND-RAISING DRIVE!

In the past several years considerable interest has been expressed by numerous members of the FPS to establish special funds that would relate

directly to the goals and purposes of our society. As such, and effective immediately, the President has established two separate funds as follows:

1. Scholarship Award Fund. The purpose of this award will be to provide a cash stipend to a deserving student that would be used to further his/her college education in paleontology, geology, or a related field. This could be (although not necessarily) an annual award derived from interest income from the endowed principle. For inquiries contact:

Ben Waller
4911 N.E. 7th Street
Ocala FL 32670
904/687-2131

Our goal: $5000, to be invested in high-interest money market funds.
Stipend: To be derived from interest income.

As it will take some time for sufficient income to grow in this fund, we can discuss the particulars of this scholarship at the next business meeting (in October 1982) and then formulate guidelines for the award.

2. "FOSSIL VERTEBRATES OF FLORIDA" Book Fund. With the great interest in vertebrate paleontology in the state, and the lack of a broad synthesis of high-quality publications on this topic, we clearly need a book on this subject to be written and published in the future. Numerous members have remarked that as a Society we could sponsor a book on this subject. At the Fall Board of Directors Meeting Webb and MacFadden agreed to co-author such a book. However we need financial support to have the photographs and illustrations prepared and for manuscript typing. The end result would be a high-quality

and current synthesis of the subject written for the informed layperson. For inquiries contact:

Clifford Jeremiah
6749 Fincannon Road
Jacksonville FL 32211
904/744-2488

Our goal: $5000, to be invested in high-interest money market funds.
Result: The principal and interest would be used to support preparation and publication costs of our book on fossil vertebrates of Florida.

SPRING FPS MEETING: Joe Larned has planned an exciting day's activities in the Bone Valley, which includes lectures, fossil hunting, and a catered barbecue luncheon. Here are the particulars:

Date: Saturday, 15 May 1982
Coordinator: Joe Larned
P.O. Box 371
Bradley FL 33835
813/428-1183

Schedule:

8:00 AM	Meet at Bone Valley Museum in Bradley
8:30 AM	Leave in convoy for C.F. Chemicals phosphate mine
9:00 AM	Orientation and slide show at plant
9:45 AM	Tour of dragline and phosphate plant
11:30 AM	Fossil-hunting
1:00 PM	Catered barbeque at plant; including ribs, cole slaw, baked beans, and rolls (Cost--$5/person).
2:00 PM	Afternoon session at plant with fossil lectures. Free coffee and donuts provided.

If you plan to attend this meeting, clip the enclosed form and mail to Howard H. Converse by May 1 (Joe needs to tell the caterer the confirmed number on that date).

FPS SPRING MEETING
10 May 1982

NAME _____
ADDRESS _____

NUMBER OF PEOPLE YOU ARE REGISTERING FOR (list names):

_____
_____
_____
_____
_____

Multiply X $5/person $ _____
TOTAL AMOUNT ENCLOSED $ _____

SEND CHECKS TO: Howard H. Converse
Secretary-Treasurer, FPS
Florida State Museum
University of Florida
Gainesville FL 32611

!!! DEADLINE FOR RECEIPT --- 1 MAY 1982 !!!

Proposed Talk (if desired):
TITLE: _____
TIME NEEDED: _____
SLIDES ? _____

THE THOMAS FARM FIELD CAMP COMMITTEE is pleased to report that it has received enough paid applications for at least one and possibly two sessions this June. The week-long field camp will include practical digging experience as well as evening discussions at the rich 20-million-year-old site in central Florida. It is still possible to reserve a place by sending your name and $100 to the FPS Secretary-Treasurer immediately. The full fee will be $200, and the dates of the camp will be the weeks of either June 14 or June 21. Phone Howard Converse (904/392-1721) if you have questions.

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FOSSIL CAMELS OF THE GULF COASTAL PLAIN

S. David Webb[1]

The most diverse order of ungulate animals are the ARTIODACTYLA (Greek for "even-toed"), including cattle, sheep, goats, camels, and pigs. For several millenia they have been important to human survival, because they provide a majority of the domesticated species from which man derives milk, meat, and such by-products as furs and leather.

Plaster Jacket No. 17 featured the suborder Suina, the pig-like division of the artiodactyls, which is represented in the New World mainly by the peccaries. This issues deals with another major group of artiodactyls, the Camelidae. They are particularly prominent in North America, for they originated here about 35 million years ago and diversified here extensively through much of the Cenozoic Era. The Old World camels and the

[1] S. David Webb, Curator of Fossil Vertebrates at the Florida State Museum and Professor of Zoology at the University of Florida, became fascinated with fossil camels as a graduate student at the University of California in Berkeley. His master's thesis, on "The Osteology of Camelops," was published in 1965. His enthusiasm for camelid evolution has persisted unabated now for two decades. The illustrations in this issue were drawn by Wendy Zomlefer of the Florida State Museum.

South American llamas are late Pliocene derivatives of native North American stocks. Thus it is a great irony for the camel family, as it is for the horse family, that they did not survive on the continent where they had experienced their greatest evolutionary successes.

The camel family originated in the late Eocene, as part of a vast adaptive radiation of selenodont artiodactyls in North America and Eurasia. Selenodont teeth are characterized by four (five in a few early examples) crescentic cusps arranged in two pairs on each molar (Fig. 1a). The upper enamel crescents are concave on their labial faces (toward the cheeks), whereas the lower enamel crescents are concave on their lingual faces (toward the tongue). In side view the peaks of the upper crescents interlock with the peaks of the lower crescents (Fig. 1b).

The functional significance of such teeth is evident when one sees a camel or cow chew. The lower jaw drops downward and to one side, then closes upward and lingually bringing the concave enamel faces of the lower molars between the concave enamel faces of the corresponding upper molars. As the enamel faces close together they shear food material trapped between the facing concave surfaces. Chewing occurs on only one side of the mouth at a time. The great success of the many selenodont artiodactyl families is perhaps not surprising, in view of their effective mechanism for chopping plant fibers.

Some selenodont artiodactyls developed a further important adaptation for making efficient use of coarse plant food: the ruminating stomach. Only two major groups of selenodont artiodactyls survived from their late Eocene radiation until the present, and it may be more than a coincidence that they both possess ruminating stomachs. They are the Camelidae and the Ruminantia. The stomach of a camel differs

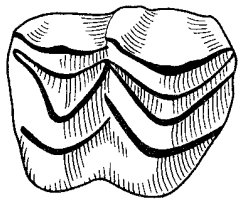

Fig. 1a. Crown view of left upper molar of a generalized selenodont artiodactyl; each of the four crescents has a lingual and a labial wall of wear-resistant enamel (thick black lines).

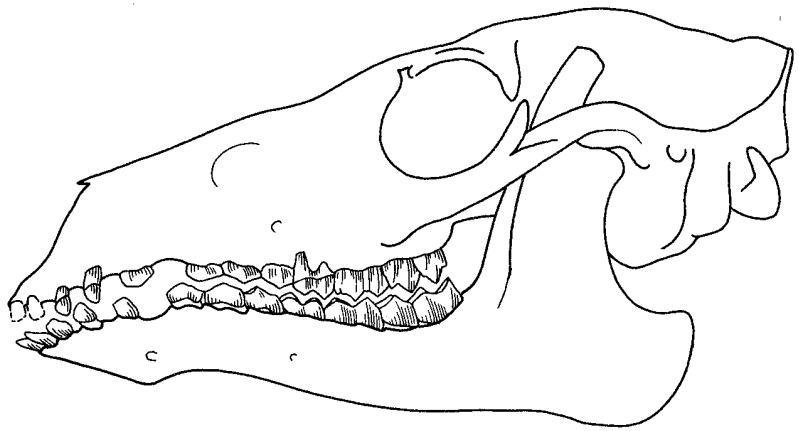

Fig. 1b. Left side view of Poebrotherium wilsoni skull from White River Badlands of South Dakota; Oligocene. (After Scott 1940)

from that of a ruminant mainly in lacking the third chamber (or reticulum), but it is also nearly absent in some small ruminants. Most importantly, a camelid has a large rumen in which plant food is broken down; in particular bacterial action derives protein from otherwise indigestible cellulose. Another advantage of the rumen is "cud-chewing," that is regurgitating poorly chewed material for further mastication while resting.

In North America the camel family emerged as one of the most successful of the selenodont families. In the Oligocene epoch there were about four genera, of which Poebrotherium is especially well-known. It had a full set of 44 teeth with very small spaces between the short incisors, canines, and anterior premolars (Fig. 1b). The cheek teeth were very simple and low-crowned. The face was short and shallow, and had an incomplete postorbital bar behind the eye socket. The skeleton is only about 60 cm at the shoulder (the size of a sheep), yet it has proportionally very long limbs and neck. The feet, too, are notably elongate and show precocious reduction of the lateral (second and fifth) toes, as compared with any contemporaneous mammals. From such beginnings came all later Camelidae.

The Miocene epoch was the heyday of camelids in North America. By then, the face was much deeper than in Poebrotherium, the postorbital bar was complete in all except Floridatragulus. There are at least two dozen genera, which can be grouped into the following four subfamilies: Stenomylinae (gazelle camels), Aepycamelinae (giraffe camels), Floridatragulinae (a very primitive branch of giraffoid camels), and Camelinae (the main trunk). The subfamily Camelinae is the most diverse and can be further divided into five tribes: The Miolabidini, the Protolabidini, the Camelopini, the Camelini, and

the Lamini. The last two tribes include the living camels and llamas respectively.

Florida and the Gulf Coastal Plain of Texas provide an excellent record of Miocene camelids (see Table 1). Although many of them have close relationships to camelids from the classic sequence of terrestrial faunas in the midcontinent, some groups of camelids were apparently endemic to the Gulf Coast and some were absent. For example, the subfamily Floridatragulinae has never been recognized in the midcontinent; whereas the remarkable little gazelle camels evidently did not enter the Gulf Coastal Region, presumably because they were adapted to more arid habitats.

The characteristic early Miocene genera are Floridatragulus, Nothokemas, Australocamelus, and a very small form similar to Gentilicamelus. Most of them are rather small with low-crowned molars and a full set of 44 teeth. Floridatragulus has an unusually elongate skull and jaw, but in many structural details it is far more primitive than the true giraffe-camels. The long rostrum has four caniniform teeth well separated from one another, the orbit is open

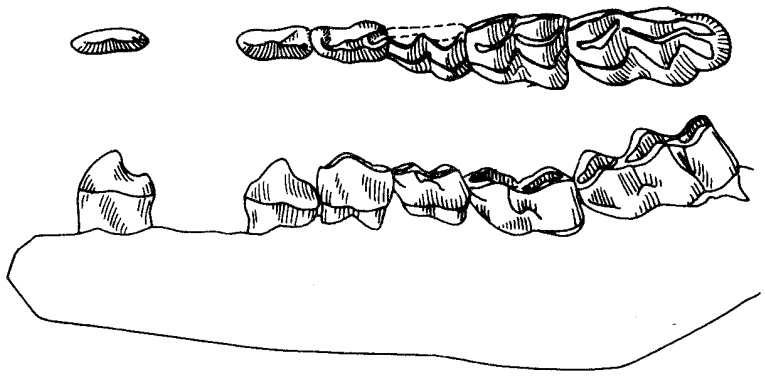

Fig. 2. Left mandibular ramus of Floridatragulus texanus from the Burkeville Fauna of the Texas Gulf Coastal Plain. Occlusal and lateral views; note diastema between second and third premolars (after Patton 1969).

Table 1.-- Fossil Camelidae in the Gulf Coastal Region.

Half Epochs	Mammal Ages	Key Faunas	Floridatragulinae
Late Pleistocene	Rancholabrean	Seminole Field Ichetucknee River	
Early Pleistocene	Irvingtonian	Coleman IIA Inglis IA	
Late Pliocene	Blancan	Haile XVA Santa Fe IA	
Early Pliocene	Late Hemphillian	Upper Bone Valley Sites	
	Early Hemphillian	Mixson's	
Late Miocene	Clarendonian	Love Bone Bed Lapara Creek	
	Barstovian	Cold Spring	*Floridatragulus hesperus*
	Hemingfordian	Burkeville	*F. texanus*
		Thomas Farm	*F. dolichanthereus*
Early Miocene	Arikareean	Garvin Gully	*F. nanus*
		Buda & SB IA	

Aepycamelinae	Camelinae			
	Miolabidini	Protolabidini	Camelini	Lamini
			Palaeolama mirifica	*Hemiauchenia macrocephala*
			P. mirifica	*H. macrocephala*
			H. macrocephala *H. blancoensis*	
			Megatylopus major	*Hemiauchenia* n. sp.
Aepycamelus major *Aepycamelus* sp.		*Protolabis coartatus* *Nothotylopus camptognathus*	*Procamelus grandis* *Megatylopus primaevus* *Procamelus* sp.	*Hemiauchenia minima*
?Aepycamelus *Australocamelus orarius*	*Nothokemas floridanus* *N. hidalgoensis* *N. waldropi* *Gentilicamelus*			

posteriorly, as in Poebrotherium, and the last lobe of the last lower molar is peculiarly divided. A distinctive feature is the gap (diastema) between the second and third lower premolars (Fig. 2).

Nothokemas was, in many ways, the most progressive early Miocene camelid. It had lost the first lower premolar, and the other lower premolars are modified by elongation and by addition of an anterolingual fold and a posterolingual cusp. The canines and incisors are very powerfully built, as is the mandibular symphysis (Fig. 3).

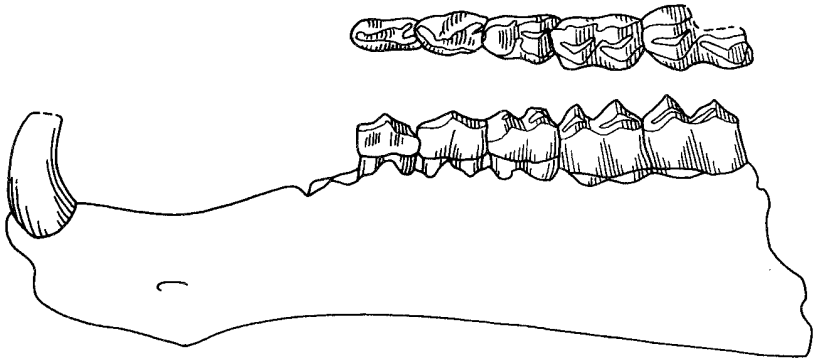

Fig. 3. Left mandibular ramus of Nothokemas hidalgoensis from the Garvin Gully Fauna of the Texas Gulf Coastal Plain; occlusal and lateral views.

Another progressive camelid of the early Miocene is Australocamelus, the earliest known representative of the giraffe camel subfamily. It is characterized by its very long jaw, transversely compressed premolars, and evidently long limbs as well (Fig. 4a). The correct assignment of the fourth early Miocene genus, from the Buda locality, is uncertain, because it is known only from isolated teeth and they have mainly primitive features. It is the smallest known Miocene camelid, most nearly comparable to Gentilicamelus. Its delicate teeth have strong ribs, stylar cusps, and intercolumnar tubercles. It is best distinguished by its short broad fourth lower premolar and its short, unfused metapodials.

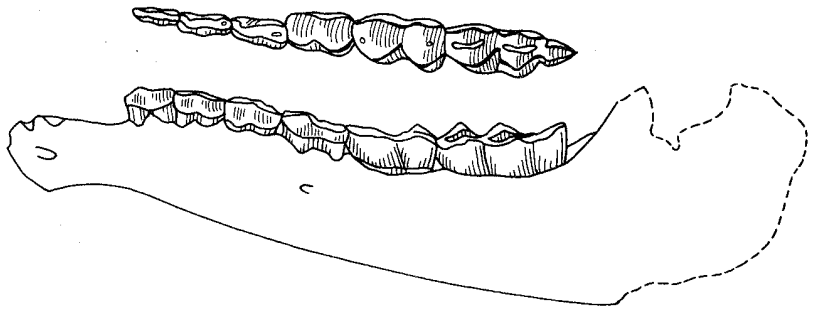

Fig. 4a. Left mandibular ramus of Australocamelus orarius from the Garvin Gully Fauna of the Texas Gulf Coastal Plain; occlusal and lateral views (after Patton 1969).

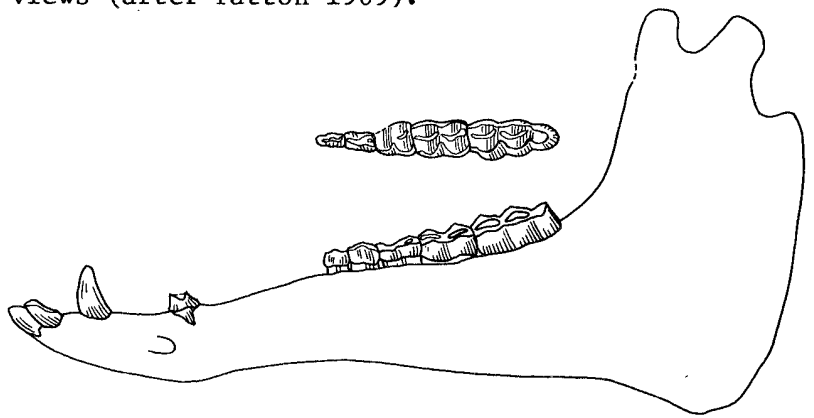

Fig. 4b. Left mandibular ramus of Nothotylopus camptognathus from the Lapara Creek Fauna of the Texas Gulf Coastal Plain; occlusal and lateral views (after Patton 1969).

By late Miocene time there had been a nearly complete turnover of camel genera in the Gulf Coastal Region, and most genera there now also ranged into the midcontinent. From Australocamelus of the early Miocene the giraffe camels persisted and were represented by their

ultimate product, the genus Aepycamelus which was fully as large as a giraffe, standing over five meters (more than 15 feet) at the shoulders. The rest of the camels were advanced members of the Camelinae, representing three tribes: Camelini, Lamini, and Protolabidini.

The genus Protolabis is best known from the early Clarendonian Lapara Creek Fauna of the Texas Gulf Coast. Among its distinctive features are a narrow rostrum, very short premolars, and a large laterally flared angular region of the mandible, suggesting very powerful masseter (cheek) muscles. A closely related genus is Nothotylopus, distinguished by its very heavy incisors and its bulbous two-rooted P_1 (Fig. 4b). Both protolabidine genera were approximately the size of a white-tailed deer and had relatively short limbs for Camelidae.

The two tribes with surviving members, namely the Camelini and the Lamini, were also well represented in the late Miocene of Florida. Even then, camelines were large and had very tall (hypsodont) grazing teeth. The two Florida genera of camelines were the large Procamelus and the very large Megatylopus. Neither genus had

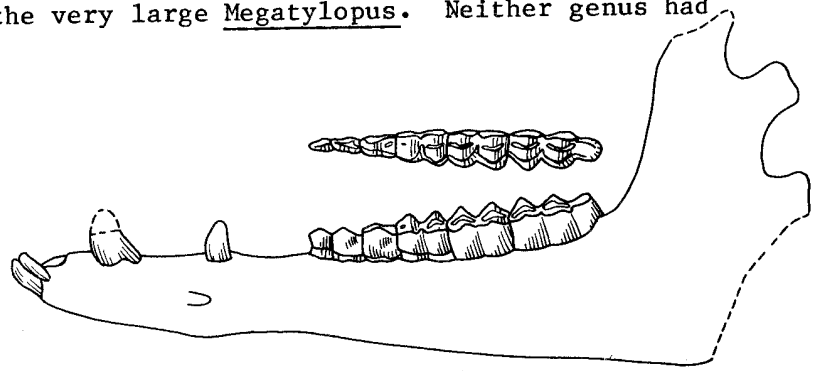

Fig. 5. Left mandibular ramus of Procamelus occidentalis from the Lapara Creek Fauna of the Texas Gulf Coastal Plain; occlusal and lateral views.

the extreme giraffoid proportions of Aepycamelus, and the metapodials were never longer than the skull. In Procamelus the second premolar was short (Fig. 5). In Megatylopus it was lost, or in the early species, M. primaevus from Lapara Creek, it was functionless.

Lamine camelids are generally more common at southern latitudes in North America, and are especially well-represented in Florida. In the late Miocene they are represented by several species, all of which are currently crammed into the genus Hemiauchenia. Some are about as tall as a modern camel, though lighter built, and others are about as tall as a modern llama, but with much longer limb proportions. Hemiauchenia is distinguished by its llama-like cheek teeth, which have very angular crescents, strong ribs and styles, and at the anterior end of each lower molar a strong "llama buttress" (anterolabial stylid).

After the late Miocene, the Florida camelid fauna loses much diversity, and after the early

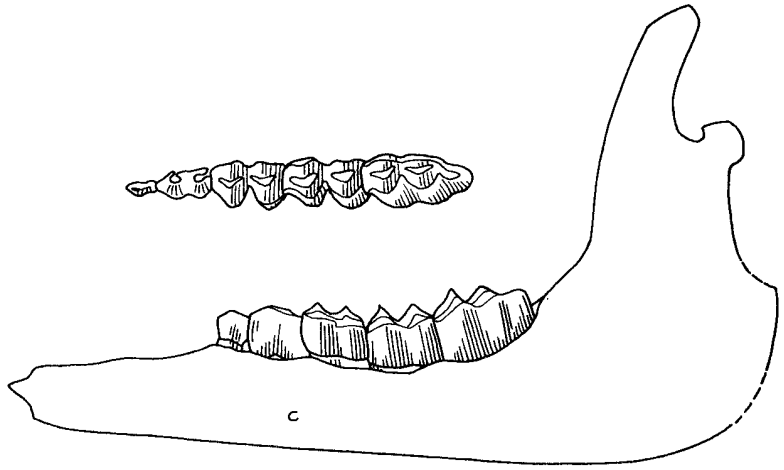

Fig. 6. Left mandibular ramus of Palaeolama mirifica from the Coleman IIA local fauna in Sumter County, Florida; occlusal and lateral views (After Webb 1974).

Pliocene is restricted to lamines. From the late Pliocene until the mid Pleistocene (late Irvingtonian) only Hemiauchenia is known. Then the genus Palaeolama appears in Florida, the Gulf Coast of Texas, and southern California. Its relatively brachydont dentition with crenulated enamel and a complex last premolar are very distinctive, and its stocky limbs suggest that it may have originated as part of the radiation of modern llamas in the Andean Region (Fig. 6). The final extinction of these lamine genera coincided with the final extinction of the large genus Camelops in western North America and many other large mammals about 10,000 years ago.

Within the rich 25-million-year record of camels in the Gulf Coastal Region, the most dramatic change occurred in mid-Miocene time about 15 million years ago. In the early Miocene the camelids were generally small and had short-crowned (brachydont) dentitions. The Floridatragulinae and the Miolabini were lost. In the late Miocene most camelids were large and had hypsodont dentitions. Both the Aepycamelinae and the three advanced tribes of Camelinae tended to lose their upper incisors. Instead they developed long procumbent lower incisors, which presumably worked against a horny cropping pad and the pendulous split upper lips, characteristic of modern camels and llamas. On the side of the face a deep pit (maxillary fossa) developed, presumably for the origin of an enlarged levator naso-labialis muscle which operates the lips. These features suggest a major adaptive shift from browsing soft vegetation to grazing coarse fodder, as in modern camelids.

Major changes also occur in the postcranial skeleton. Early Miocene camelids had dainty hoofs, about as in a deer. In most late Miocene camelids, however, the feet dropped down onto

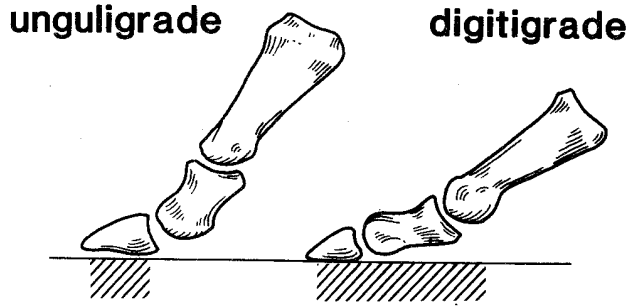

Fig. 7a. Lateral view of a camelid foot (at the phalanges) illustrating the shift from an unguligrade (deer-like) stance as in Oxydactylus in the early Miocene to a digitigrade (padded support) stance as in Procamelus of the later Miocene (after Webb 1972).

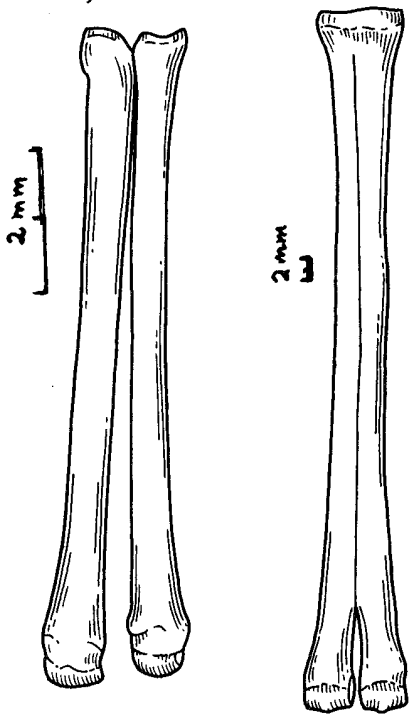

Fig. 7b. Front view of a camelid foot (above the phalanges) illustrating the shift from a short unfused pair of metatarsals, as in Poebrotherium, to a very long fused pair of metatarsals, as in Procamelus. One cannon bone of Aepycamelus from the Love Bone Bed is 898 mm long.

broad padded bases, as in modern camelids (Fig. 7a). At about the same time the two long bones of the feet (metapodials) became much longer and were soon fused together (Fig. 7b). The lower ends still diverged strongly, a distinctive feature of advanced camelids. These were evidently adaptations to efficient locomotion in open country and also to stable support on a sandy substrate. The presumed predilection of these advanced grazing camelids for open country helps explain why they were able to cross into Asia and into South America when the opportunities arose in the late Pliocene. The final extinction of camelids in North America provides a sad ending to a long exciting history.

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