BUREAU OF ECONOMIC GEOLOGY
The University of Texas
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JOHN T. LONSDALE, Director

Report of Investigations—No. 14

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James Harrison Quinn

New information concerning the ancestry of the later Tertiary horses, *Calippus*, *Protohippus* (in the original sense), *Hipparion*, *Neohipparion*, and *Nannippus*, has been obtained from a restudy of the various mammalian faunas of the Coastal Plain in Texas, based in the main on the extensive collections of the Bureau of Economic Geology, The University of Texas. The age, stratigraphic correlation, and composition of these faunas have been reevaluated, and the results provide new evidence that has important bearing on Miocene and Pliocene intercontinental correlations of mammalian faunas. It is the opinion of the writer that these five genera of horses, among which the three genera *Hipparion*, *Neohipparion*, and *Nannippus* are commonly called the *Hipparion* group, originated from the lower Miocene genus *Parahippus* and hence made their first appearance in the middle Miocene.

The late Tertiary mammalian faunas of the Texas Gulf Coastal Plain occur in three discrete horizons which, according to previous workers (Wood et al., 1941), are distributed as follows: middle Miocene, represented by the Cedar Creek and Garvin Gulley local faunas; upper Miocene to lower Pliocene, represented by the Noble Farm local fauna and Cold Springs and Burkeville faunas; lower to middle Pliocene, represented by fossils of the Goliad formation.

The Cedar Creek and Garvin Gulley local faunas are segments of a fauna contained in the lower Oakville sandstone. The sandstone is known to extend from Duval County, near the Mexican border, to a few miles northeast of Navasota, Grimes County, but may actually be traceable farther east, although it may no longer be a prominent scarp-forming sandstone in eastern Texas. The Oakville sandstone overlies the Catahoula formation, of supposed Oligocene age. The fauna contained in the Oakville sandstone has been traced from the locality of Cedar Creek to that of Garvin Gulley. For present purposes the fauna may be called the Oakville fauna.

The age of the Oakville fauna is apparently Arikareean, just earlier than the Thomas Farm local fauna, in Florida, of the Tampa(?) formation. The presence of *Tomarctus canavus*, *Floridatragulus*, *Oxydactylus*, *Parahippus leonensis (vellicans)*, and other forms specifically common to the two faunas attests to the closeness of time relationship between them. However, the Thomas Farm fauna contains a somewhat more advanced form, *Merychippus gunteri*, not found in the Oakville. It would thus appear that the Florida horses are a little more advanced, and the Thomas Farm fauna is correspondingly slightly younger than the Oakville fauna of Texas.

A series of fossiliferous strata overlying the Oakville and known as the Fleming (or Lagarto) formation contains a diverse fauna, which may be designated the Fleming fauna. It embraces the Cold Springs, Noble Farm, and Burkeville local faunas. In the vicinity of Burkeville commingled vertebrate and terrestrial and aquatic invertebrate fossils occur. The Burkeville horizon has been correlated by its invertebrates with the middle Miocene, Florida Hawthorne (Stenzel, Turner, and Hesse, 1944, pp. 997–1000).

Remains of *Floridatragulus*, *Tomarctus canavus*, and horses very closely related to *P. leonensis*, but with the crotchet attached, are found in the base of the Fleming. Hence a very close time relationship is indicated between the basal Fleming, the Thomas Farm local fauna in Florida, and the Oakville fauna, with the first-listed the youngest and the last-listed the oldest.

Although mastodonts, *Alticamelus*, and *Teleoceras* appear in the middle of the Fleming and not earlier, the Fleming fauna seems to represent a single unit, since some species persist without noticeable change from the base to the top of the formation, as known at present.

Among the horses all the Pliocene groups except *Pliohippus* are present in the Fleming fauna. Of these *Calippus* is represented by a large and a small species and is more easily recognized than any of the other genera. A *Protohippus* much like *P. perditus* but with considerably shorter-crowned teeth is sparsely represented. Of the *Hipparion* group, *Nannippus* and *Neohipparion* can be distinguished, but separation is difficult. A number of isolated teeth have round-oval protocones and very complexly folded enamel. These appear to represent ancestral Hipparions.

All these horses are obviously more primitive than their Pliocene descendants, but they are generically separable and cannot be assigned to the genus *Merychippus*. Furthermore, these horses cannot be considered as belonging in the Pliocene or upper Miocene. The fauna contains forms that may be considered relict, such as *Desmathyus* and *Diceratherium*. However, the species of genera more properly associated with a later stage, such as *Teleoceras* and *Aelurodon*, are much more primitive than are the late Miocene or Pliocene species of these genera. Likewise the marine correlation indicates middle Miocene. All available evidence leads to the conclusion that the Fleming is middle Miocene in age, its base lower middle Miocene, and its top not later than upper middle Miocene.

The Goliad formation overlies the Fleming and is best exposed in the Beeville-Goliad area. The fauna, which may be called the Goliad fauna, seems to be closely related to the Clarendon fauna insofar as the teleocerine rhinoceroses and certain of the horses are concerned. *Pliohippus* is sparsely represented; *Calippus placidus* and *regulus* are not uncommon. *Neohipparion* and *Nannippus* are quite numerous. There are other horses in the fauna including a large calippine and a hipparionid, which has round-oval protocones and complexly folded enamel patterns and is probably referable to *Hipparion*. The fauna also includes *Amphicyon*, *Aelurodon*, *Alticamelus*, *Procamelus*, *Synthetoceras*, *Merycodus*, and *Gnathybelodon*. Of these *Gnathybelodon* is the only animal which might indicate a later, Pliocene, age. However, presence of horses in the Goliad, not known in the Texas High Plains deposits, indicates a slightly earlier age for the Goliad. Because the two areas are so closely situated geographically, it would seem that the faunas should be almost identical if they were of the same age. Certainly the Goliad fauna resembles the Clarendon much more closely than the Fleming.

The Gulf Coast faunas of the Miocene appear to be distinct from those of the Great Basin and the West Coast as well as those of the High Plains. Separate faunal provinces, with restricted communication but not complete isolation, are indicated. The nature of the barriers is not known. These restrictions to intermingling seem to have been relaxed at the end of Miocene time, permitting the Gulf Coast faunas to invade the North.

In conclusion, the Texas Gulf Coast formations contain faunas of lower, middle, and upper Miocene age, distinct from those of the North and West. These Texas faunas include the hitherto not recognized ancestors of various genera of Pliocene mammals. Of these, certain of the horses are not referable to the genus *Merychippus*, and *Merychippus*, in the generally accepted sense, can no longer be considered as ancestral to the Pliocene genera. The horses from the Fleming are primitive members of *Calippus*, *Protohippus*, *Nannippus*, *Neohipparion*, and *Hipparion*. Finally, the Gulf Coast beds can be related to the continental Florida lower Miocene, the marine middle Miocene Hawthorne section, and the High Plains formations.

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NEW PALEOCENE AND LOWER EOCENE VERTEBRATE LOCALITIES, BIG BEND NATIONAL PARK, TEXAS

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During the course of a comprehensive geological survey of Big Bend National Park, Brewster County, Texas, Maxwell and Lonsdale noted strata of questionable age in the valley of Tornillo Creek north of the Chisos Mountains. This is the general type locality of Udden's (1907) late Cretaceous Tornillo formation, and the area along the creek for several miles is known locally as Tornillo Flat. The strata in question consist of ledge-making, buff, cross-bedded sandstone about 35 feet in thickness including locally lenses of conglomerate at the base. The conglomerate contains well-rounded cobbles up to fist size of Paleozoic and Cretaceous limestone and chert but no igneous cobbles. Beneath the sandstone is poorly bedded vari-colored clay containing lenses of sandstone and thin lignitic beds. In places the clay is channeled by sandstone to depths of about 10 feet. The clay beds correspond closely to Udden's description of the Tornillo. Above the sandstone are clay, tuffaceous sandstone, and tuff which commonly have been regarded as Tertiary in age.

Dr. S. S. Goldich of the University of Minnesota suggested to Maxwell and Lonsdale in 1948 that the sandstone and conglomerate probably are of Tertiary age. He had traced a basal Tertiary conglomerate southward from the southern Davis Mountains area nearly to Big Bend National Park and thought that the rocks along Tornillo Creek might be the same. On July 10, 1951, Wilson found a lower jaw of *Coryphodon* in the clay below the conglomerate. In February 1952, the writers spent several days extending Wilson's observations over the Tornillo Flat area where the rocks are exposed.

This reconnaissance produced the following results:

1. Discovery of a distal end of a femur of eohippus and a tooth fragment of *Coryphodon* in the basal conglomerate at the bottom of the sandstone.

2. Discovery of eohippus teeth and *Coryphodon* bones, turtles and crocodilian fragments in the clays below the conglomerate.

3. Discovery of a *Periptychus* lower jaw fragment, multituberculate fragments, and several unidentified jaw fragments in silts and sandstone about 150 feet stratigraphically below the sandstone.

It is possible thus to announce the discovery of a new and important locality for Paleocene and lower Eocene beds in Texas. This means also that a part of the strata formerly included in the Tornillo in this area are Paleocene and lower Eocene in age. In addition, this discovery probably will be of value in correlating the lower parts of the extensive Tertiary section of west Texas. This newly discovered Tertiary vertebrate locality apparently contains a rich and varied fauna, and it is hoped that future work will substantially increase the knowledge of the life of the lower Tertiary.

The Secretary of the Interior has granted a permit to collect and study the fossils from these strata in the park area. The Bureau of Economic Geology, The University of Texas, will organize a field project for this purpose in the near future. Wilson will be in active charge of the project in which also Maxwell and Lonsdale will participate.

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