Art. XIII.—*Leptauchenia and Cyclopidius;* by F. B. Loomis.

The aberrant phylum of oreodonts represented by the genera Leptauchenia and Cyclopidius appears suddenly in America in late Oligocene times, without a trace of intermediate types by which to link it to the other oreodonts. It is found in the Leptauchenia beds of South Dakota and Wyoming, the Lower Rosebud formation of South Dakota, Nebraska and Wyoming, and the Deep River beds of Montana, completely disappearing thereafter. During this brief period, these animals change by progressively shortening the already short skull, and by reducing the three tiny incisors of each jaw to two. This is the specific change by which Leptauchenia is distinguished from Cyclopidius, but besides this the skull of Cyclopidius is shorter and much heavier in build. As the incisors are so tiny that they are seldom preserved, this relative heaviness and shortness of the skull becomes the important criterion for distinguishing relationships in this group.

The finding of a skeleton of Cyclopidius directed my attention to the group; and, as the species and genera have been considerably confused, I have examined all the known material of these two genera in the various museums, in addition to the skeleton and considerable series of skulls which we collected in the Leptauchenia and Lower Rosebud formations.

The genus Leptauchenia was established by Leidy in 1856, with L. decora as the type species, to which he later added L. nitida and L. major from the same upper Oligocene beds. In 1878 Cope added four species under three generic names, Cyclopidius simus, C. heterodon, Pithecistes brevifacies and Brachymeryx feliceps, all from the Deep River beds. Before the end of the year he recognized that his Brachymeryx was the young of Cyclopidius simus. In 1884 he added two more species, C. emydinus and P. decedens, also from the same beds. In 1893 Scott described another species, C. incisivus, from the same Deep River beds. In 1899 Matthew did a little supplementary preparation on the type of Pithecistes and found its dental formula the same as that of

Cyclopidius, throwing all the above six species into the genus Cyclopidius. In 1910 Sinclair made a restoration of Leptauchenia decora, using both L. decora and L. nitida as material. Thorpe, in 1921, described the species C. lullianus from the Lower Rosebud and also the genus Chelonocephalus with the type species C. schucherti.

On the skeleton of Cyclopidius (Fig. 1), found in the Lower Rosebud, 25 miles south of Torrington, Wyo., the general features of both this genus and of the phylum can be readily seen. The skull is disproportionally large and heavy, more so than in the case of Leptauchenia, and it is excessively shortened from front to back, especially the front portion. At the same time it is deepened and the lower jaw is of unusual depth. One of the striking features is the high position and protrusion of the large orbit. The antorbital vacuity is the largest found in any oreodont genus, expanding until it meets the nasal bones, and extending backward to between the orbits. As a result of this expansion, the nasal bones are narrowed all along their length except the anterior ends, which expand and unite suturally with the upward processes of the maxillæ. These maxillary processes are also the result of the antorbital vacuity having cut out the portion of the maxilla normally behind the present processes. The premaxillæ are reduced to tiny bones below the nasal opening, and carry the tiny incisors. In Leptauchenia the jugal bones and arches are wide, but they are progressively wider in the later forms like Cyclopidius. This is associated with the increased depth of the lower jaw, especially its back portion. The rear of the skull is widened and both the sagittal and lambdoidal crests are highly developed. The exoccipital bones are widened, making the rear face of the skull the flattest and widest of any of the oreodonts. In these exoccipital bones either pits or vacuities may occur, situated just behind the auditory meatus. The bullae are of enormous size, the largest known in Oreodontidae, and the auditory meatus is directed upward and backward, often opening as far back as opposite the occipital condyles.

The dentition is hypsodont, the most so of any oreodont. The molars are large and powerful, and usually occupy

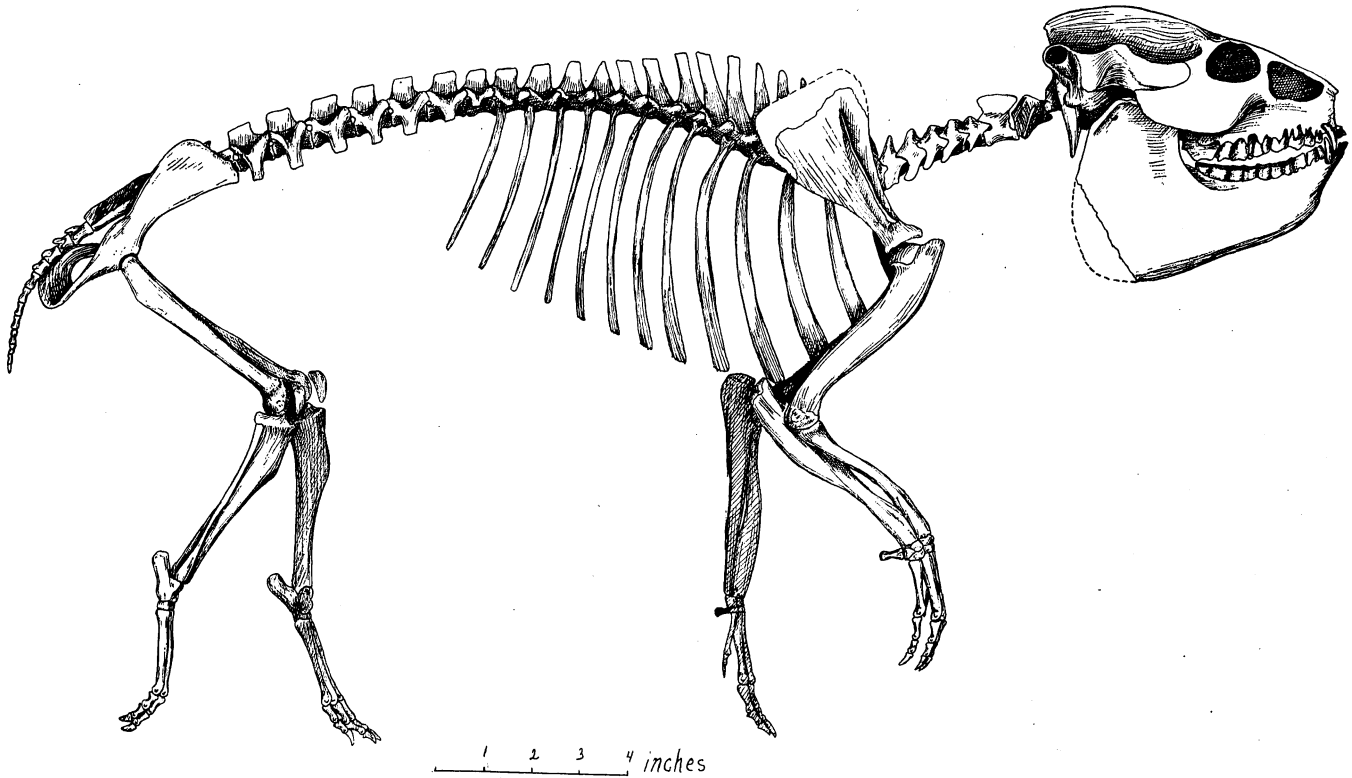

Fig. 1.—Skeleton of Cyclopidius lullianus, about ¼ natural size.

more than half again as much space as do the premolars. The premolar series is always short and the teeth crowded. The upper molars are those typical of the whole oreodont phylum as far as pattern goes. Upper premolar 4 (apparently a half molar) is formed by the development of the posterior half of the tooth, the anterior half being almost entirely lost as is typical in Oreodontidae. In Leptauchenia, if the teeth are but slightly worn, a tiny pit is found in the anterior external corner, the last remnant of the anterior portion of this tooth, but even this is lacking in Cyclopidius. Upper premolars 3, 2 and 1 are similarly formed in both Leptauchenia and Cyclopidius, the posterior half being fully developed, while the anterior portion is reduced, causing the teeth to appear as if set obliquely in the jaw (see Fig. 3). The lower molars are those typical of Oreodontidae, except that they are hypsodont. Premolar 4 is unique in the enormous swelling of the posterior crest, so that it fills the whole posterior basin (see Fig. 4), while the premolars in front of this one show a similar character in a lesser degree. In this tendency for the anterior premolars to be similar to the fourth one, we note a progressiveness unusual in the Oreodontidae, though typical of some of the other phyla of artiodactyls, as the deer, bovidae, etc.

As noted above, the body of Leptauchenia or Cyclopidius is small and light in contrast to the skull. Sinclair in his vertebral formula has 14 dorsal and 6 lumbar vertebrae, but my series, which was found intact and articulated from the atlas to the sacrum, shows 13 dorsals and 7 lumbars. There is little about them different from the usual oreodont vertebrae. The ribs, however, are unexpectedly light, and toward the rear change from flat to cylindrical, the posterior ribs being slender rods. Both limbs are of moderate length and extremely light. The radius of the front limb is curved to a greater degree than I have seen in any other oreodont, which with the lightness of the whole leg, seems to indicate great agility. The fore foot, unexpectedly, shows five toes, the first being reduced, but having all the phalanges present. This reminds us of Merycoidodon, and is a primitive character not retained in other Miocene representatives of the phylum. The hind limb offers nothing different

from that of typical oreodonts, there being the usual four toes.

Leptauchenia is the less specialized genus of this phylum, having a lighter build and $\frac{3}{3}$ incisors. To the three species already known, I would add another from the Lower Rosebud formation, under the name

Leptauchenia densa sp. nov.

Type No. 22-595 in the Amherst College collections, from the Lower Rosebud at Muddy Creek, eastern Wyoming.

FIG. 2.

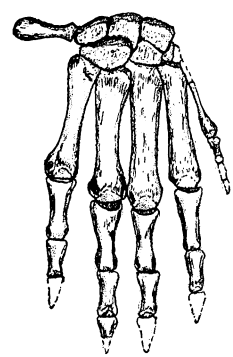

Fig. 2.—Cyclopidius lullianus, front foot of the skeleton showing the presence of the first digit.

The species is erected for some 20 specimens from both Muddy Creek,* or as it is often designated, the Spanish Mines, and from the south side of Goshen Hole, both localities in Wyoming, and both representing Lower Rosebud time, as indicated by the presence of Mesoreodon megalodon, Merychyus curtus, and Eporeodon relictus, all species characteristic of the Lower Rosebud further east in South Dakota.

In the length of the skull and in the dentition this species is between L. decora and L. major of the underlying beds, but the lower jaw and jugal arch are half again as heavy as in either of these two species. Throughout L. densa is heavily built, where the other

* This bed has been erroneously referred to by Lull, Thorpe and myself as Lower Harrison in our earlier papers.

two species are light, and the new species has the whole skull more shortened from front to back. While the total length of the skull is shorter than that of L. major, the molar dentition is longer and the premolar dentition shorter, showing a marked tendency to measurements which would rather characterize a species of Cyclopidius.

FIG. 3.

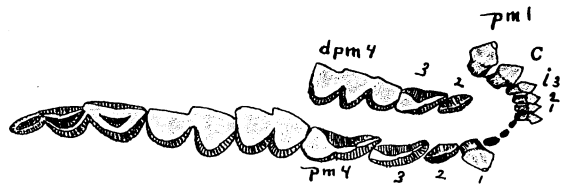

Fig. 3.—Upper premolars and molars of the left side of the type specimen of Leptauchenia densa, nat. size. Above the deciduous premolars.

The dentition is strongly hypsodont as is typical of the genus. Upper premolar 4 has no pit in the anterior external corner. Upper premolar 3 is markedly shortened from front to rear by the reduction of the anterior portion, and this is also true of premolars 2 and 1, although to a less degree. In the lower dental series, premolar 4 is characterized by the extreme thickening

FIG. 4.

Fig. 4.—Lower premolars and molars of the right side of Leptauchenia densa, nat. size. Above the deciduous premolars.

of the posterior crest, and premolar 3 shows the same characteristic, although to a less degree. The milk teeth show the same characters as the permanent, and are typical of the phylum. The fourth upper deciduous premolar is molariform, while the tooth in front of it corresponds roughly to the third permanent premolar. In the lower milk series, the fourth premolar resembles

molar 3 of the permanent dentition, though even more advanced in that its three lobes are all about equally developed. Deciduous premolar 3 roughly corresponds to permanent premolar 4. Attention is called to these resemblances, because, when single teeth are found, it is easy to identify a deciduous premolar, as an adult tooth of some smaller species.

There are no other species with which this one is likely to be confused, and it is probably the same as the specimen described by Thorpe as L. cf. decora from the Lower Miocene southwest of Chadron, Neb.

So far as described, the species of Leptauchenia are as follows:

Age	Length of skull	Length of upper molar series	Length of upper premolar series
L. nitida			
Leptauchenia beds	95-100 mm.	25-27 mm.	20-22 mm.
L. decora			
Leptauchenia beds	107-110	28-30	17-20
L. major			
Leptauchenia beds	139	40	35
L. densa			
Lower Rosebud beds	123-128	44-45	25-27

Cyclopidius Cope.

The genus Cyclopidius has the characters of Leptauchenia, except that the incisors are reduced to $\frac{2}{2}$, and the skull is throughout shorter and heavier, which is expressed in the molars occupying proportionally more, and the premolars proportionally less of the total length of the dental series. In the Lower Rosebud there is one species of this genus, C. lullianus, the skeleton of which is here used to illustrate the whole group, while from the Deep River beds no less than six species have been described. Of these Cope quickly recognized that his Brachymeryx feliceps was a young Cyclopidius simus. Matthew in 1899 showed that Pithecistes breviceps was in reality Cyclopidius simus. In the Deep River material I can find but two types of Cyclopidius, one with a short snout, in which the molars occupy about 36 mm. and the premolars 16 or 17 mm.; the other with a longer snout, the molars occupying about 34 mm., and the pre-

molars 25 mm. I therefore consider not only Brachymeryx feliceps and Pithecistes breviceps, but also C. (Pithecistes) decedens and C. (Pithecistes) heterodon as synonyms of C. simus. C. emydinus illustrates the long snouted type, and I can see nothing to distinguish C. incisivus from it; so I consider the latter as a synonym of the former.

Thorpe erected another genus under the name Chelonocephalus with C. schucherti as its type. This is an exaggerated Cyclopidius, and it is largely a question of personal judgment as to how much a species must deviate in order to require a separate genus. I should include this species with the others under Cyclopidius.

The following chart indicates the comparative characters of the several species:

Age	Length of skull	Length of upper molar series	Length of upper premolar series
C. lullianus Lower Rosebud	142-168	44-48	30-31
C. simus, Deep River		36	16
C. emydinus, Deep River	132	33-37	23-24
C. schucherti Lower Miocene	93	28	20

One other item is suggested by this material, and that is that the Deep River beds, instead of being considered as Middle Miocene, are rather closely associated with the Lower Rosebud, and represent a phase of Lower Miocene time, not much later than the Lower Rosebud. Apparently these Leptauchenia and Cyclopidius forms came suddenly and disappeared suddenly. They are not found in such beds as the Lower and Upper Harrison nor in the Upper Rosebud, all of which are well explored and considered Lower Miocene. Further in the fauna of the Deep River I see such genera as Promerycochoerus, Mesoreodon, Merychyus and Ticholeptus, all Lower Rosebud genera; nor do such genera as Parahippus, Hypohippus or Blastomeryx suggest higher position. The Deep River is later than the Lower Rosebud, but I can not feel it is much later. I should put Deep River as almost immediately following Lower Rosebud in time.

LITERATURE LIST.

Leidy, 1856, Proc. Acad. Nat. Sci., Phila., vol. VII, p. 88-90.
Leidy, 1869, Jour. Acad. Nat. Sci., Phila., (2) vol. VII, p. 122.
Cope, 1878, Proc. Amer. Philos. Soc., vol. XVII, p. 219-231.
Cope, 1878, Amer. Naturalist, vol. XII, p. 58.
Cope, 1884, Proc. Amer. Philos. Soc., vol. XXI, p. 553-8.
Scott, W. B., 1890, Morph. Jahrb., vol. XVI, p. 353.
Scott, W. B., 1893, Trans. Amer. Philos. Soc., vol. XVI, p. 163.
Matthew, W. D., 1899, Bull. Amer. Museum Nat. Hist., vol. XII, p. 73.
Sinclair, W. J., 1910, Proc. Amer. Philos. Soc., Phila., vol. XLIX, p. 196.
Thorpe, M. R., 1921, this Jour., vol. CCI, p. 415.
Loomis, F. B., 1924, Bull. Amer. Museum, Nat. Hist., vol. LI, p. 14.