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THE UPPER PALEOCENE MAMMALIA FROM THE ALMY FORMATION IN WESTERN WYOMING

(WITH 2 PLATES)

BY

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INTRODUCTION AND HISTORY OF INVESTIGATION

Repeated, intensive search of a comparatively small exposure area of the Almy formation in western Wyoming has, over the past 15 years, resulted in a faunal representation of about a dozen mammalian species. This is, no doubt, a rather meager sample of the probable fauna although based on a little over 70 determinable specimens. It is, nevertheless, an interesting increase, from the original five forms recognized (Gazin, 1942) on but nine specimens. The Clarkforkian upper Paleocene age interpreted for the scant, earlier materials now seems clearly indicated by the collections as a whole.

The locality consists of a small cluster of closely adjacent exposures on the north side of La Barge Creek about 7 miles due west of the town of La Barge, formerly Tulsa P. O., in Lincoln County, Wyo. The most productive of these has been one in the vicinity of a topographic saddle, bare of vegetation, at the head of a ridge along the southeast side of Buckman Hollow (see advance sheet, U.S.G.S. La Barge quadrangle) in NW¼NE¼ sec. 12, T.26 N., R.114 W. Other localities worthy of mention are on the southeast side of the above ridge, nearer the highway, and on the ridges to the northwest of Buckman Hollow in the vicinity of Spring Creek.

Discovery of these localities, as has been previously noted, was made by J. B. Reeside, Jr., B. N. Moore, and W. W. Rubey of the U. S. Geological Survey in 1936. Discovery by Rubey and John Rodgers in 1939 of *Plesiadapis* material at one of the sites provoked our interest, and in 1941 an additional small collection was made by

G. F. Sternberg, Franklin Pearce, and myself. The result of these early searches was the nine specimens described in the preliminary note of 1942. Smithsonian Institution parties revisited the localities in 1948, 1949, 1951, 1953, and 1954. On most of these expeditions I was assisted by the chief of our laboratory of vertebrate paleontology, Franklin L. Pearce. In 1948, I was aided by my wife, Elisabeth, and son, Chester. Chester Gazin also assisted Pearce and me in 1949.

The excellent pencil drawings of specimens shown in the two plates accompanying this report were made by Lawrence B. Isham, scientific illustrator for the Department of Geology in the National Museum.

GEOLOGIC RELATIONS AND OCCURRENCE OF REMAINS

Although the fossil-bearing beds on La Barge Creek have been mapped by A. R. Schultz (1914) as Almy, and are so regarded by Rubey [1] in his recent investigations of the region, it should be noted that the type section for the Almy formation, in the vicinity of Evanston, Wyo., is in a separate, although adjacent, basin of Tertiary deposition and there may have been no actual continuity between the two lithologically somewhat similar deposits.

The Almy formation is mapped in the Upper Green River Basin as a nearly continuous band along the east flank of the Wyoming Range from the vicinity of La Barge Creek to Fall River in the Hoback Basin. At La Barge Creek it appears and is shown by Schultz to be in depositional contact with lower Paleozoic rocks to the east and with upper Paleozoic and Triassic rocks forming the front of the range to the west. The Almy area immediately to the north of La Barge Creek is separated from the Eocene of the Green River Basin on the east by faulting, shown as a thrust by Schultz in which the lower Paleozoic beds underlying the Almy have ridden out over the younger rocks to the east. To the south of La Barge Creek the Paleozoic rocks which make up La Barge or Hogsback Ridge, together with the trace of the thrust fault, disappear beneath the Eocene of the Green River Basin, with the Knight formation extending westward to contact with the Almy, as it does again some distance to the north.

In the vicinity of the fossil occurrences the Almy beds are a reddish, pebbly clay, partly conglomeratic, dipping steeply to the southwest toward La Barge Creek. They appear to be nearly conformable

[1] Oral communication.

with the underlying Paleozoic limestones in Buckman Hollow, a relationship, of course, of a strictly local character. The various fossil sites are nearly all very low in the section and at the topographic saddle formed at the head of the ridge bounding Buckman Hollow on the southeast scattered remains were found to within only a few feet of the underlying limestone. A locality on the southeast side of this ridge and nearer the road, which produced the type of *Phenacodus almiensis,* would appear to be a little higher in the section. *P. almiensis,* however, is well represented by materials from the lowest levels so that the stratigraphic difference in this instance would not appear to have faunal significance.

THE ALMY FAUNA

There follows a listing of the forms encountered in the Almy collections and an indication of the number of specimens recognized as representing each:

PRIMATES:	
Plesiadapidae:	
Plesiadapis rubeyi Gazin	2
Plesiadapis cookei Jepsen	3
Plesiadapis? pearcei, new species	2
Carpolestidae:	
Carpolestes, cf. *dubius* Jepsen	1
CARNIVORA:	
Arctocyonidae:	
Anacodon? nexus, new species	1
Mesonychidae:	
Dissacus, sp.	2
Miacidae:	
Didymictis?, sp.	1
CONDYLARTHRA:	
Phenacodontidae:	
Ectocion ralstonensis Granger	13
Ectocion, cf. *osbornianum* (Cope)	4
Phenacodus almiensis Gazin	32
Phenacodus primaevus Cope	10*
DINOCERATA:	
Uintatheriidae:	
Probathyopsis?, sp.	2

* Eight of these are of a smaller form tentatively regarded as *P. p.,* cf. *intermedius.*

AGE AND CORRELATION OF THE FAUNA

The fauna above listed is beyond doubt a Clarkforkian assemblage. It is interesting to note, moreover, that all the genera, except *Car-*

polestes, and certain of the species are also lower Eocene. Nevertheless, this fact, together with the relative abundance of condylarths and *Plesiadapis,* and absence of the more common Eocene forms such as *Hyracotherium, Homogalax, Hyopsodus, Diacodexis, Pelycodus,* etc., is regarded as characterizing Clark Fork time.

It is of further interest that all the genera here recognized are also either Tiffanian or, as *Ectocion* and *Anacodon,* arbitrarily distinguished from Tiffanian ancestral forms. This is regarded as further characteristic of Clark Fork time, i.e., the bulk of the Clark Fork fauna is a survival of a certain selection of known Tiffanian lines with the appearance of very few new stems from elsewhere. It would appear then that recognition of Clarkforkian time as distinct from Tiffanian on a generic level is, as in comparison with the Eocene, somewhat negative in character, partly depending upon the absence of a number of forms comparatively common in the earlier beds but presumed to have become extinct. Nevertheless, the species for the most part are advanced over those of Tiffanian time and we have in the Almy, for example, such forms as *Plesiadapis cookei, Anacodon? nexus, Ectocion ralstonensis, E.,* cf. *osbornianum, Phenacodus almiensis* and *P. primaevus.* From the Clark Fork beds in the Big Horn Basin there may be added to this list of progressive species such forms as *Thryptacodon antiquus, Didymictis protenus, Haplomylus speirianus,* and a species of *Coryphodon.*

The further evidence given the distinctiveness of Clark Fork time by the first known appearance of tillodonts and palaeanodonts calls attention to the comparatively few new lines that appear, evidently introduced from some other area, in contrast with the strikingly large and important part of the Eocene fauna that appeared at the end of Clark Fork time. This emphasizes the appropriateness and, undoubtedly, formed part of the reasoning followed in regarding Clarkforkian as upper Paleocene rather than Eocene, thereby permitting factors of a regional or perhaps greater importance that must have affected the faunal distribution to be correlated with an important time boundary.

SYSTEMATIC DESCRIPTION OF THE MAMMALIAN REMAINS

PRIMATES

PLESIADAPIDAE

PLESIADAPIS RUBEYI Gazin, 1942

Plate 1, figure 10

No additional material of this species has been found since description of the original Geological Survey collection. Included is the type

(U.S.N.M. No. 16696), a right mandibular ramus with P_3-M_2, but lacking the trigonid of M_1, and a left M^3 tentatively referred to *Plesiadapis rubeyi.*

P. rubeyi clearly belongs to the group of species that includes *P. gidleyi, P. fodinatus, P. dubius,* and probably *P. cookei.* It is remote from the distinctive *P. jepseni–P. anceps–P. rex* group or subgenus. It is, moreover, rather close to *P. fodinatus* which Jepsen (1930) described from the Silver Coulee horizon of the Polecat Bench sequence. There is a possibility that *P. rubeyi* is not specifically distinct from *P. fodinatus;* however, in view of the distinctly small size of M_1, the anteroposteriorly shorter appearing summit of the trigonid of M_2, and the comparatively slender premolars showing an incipient metaconid on P_4 (as in *P. dubius* rather than *P. fodinatus*), the species *P. rubeyi* would seem to be valid. Moreover, *P. fodinatus* is typically Tiffanian in age, regarded as represented in the Bison Basin deposits and Fossil Basin Evanston(?) as well as in the Polecat Bench, and survival of this species into Clarkforkian time, though likely, awaits demonstration.

The tentatively referred last upper molar (U.S.N.M. No. 16697) is distinctly large for the type lower jaw of *P. rubeyi* and is posterolingually expanded somewhat as in *P. fodinatus.* It is possible that this tooth represents *P. fodinatus,* but the evidence is rather meager and would not seem to justify separate listing. The tooth measures 4.3 mm. anteroposteriorly by 6.0 for the greatest transverse diameter.

MEASUREMENTS IN MILLIMETERS OF LOWER TEETH IN TYPE SPECIMEN OF *Plesiadapis rubeyi,* U.S.N.M. NO. 16696

P_3, anteroposterior diameter : transverse diameter	2.8 : 1.9
P_4, anteroposterior diameter : transverse diameter	2.9 : 2.2
M_1, transverse diameter of talonid	2.7
M_2, anteroposterior diameter : transverse diameter of talonid	3.7 : 3.2

PLESIADAPIS COOKEI Jepsen, 1930

Plate 1, figures 5-8

In addition to the lower jaw of *Plesiadapis cookei* (U.S.N.M. No. 16698) found in 1941, a second lower jaw with all three molars and an isolated M^3 were found by Franklin Pearce while in the field with me in 1954. *Plesiadapis cookei* is truly gigantic in comparison with other Paleocene primates and is nearly as large as the upper Bridgerian *Notharctus robustior.* Direct comparison of these jaw materials with the type specimen in the collections of Princeton University shows near identity in size and character of the teeth for the

1941 specimen, verifying the tentative assignment of the Buckman Hollow Almy form made in 1942. U.S.N.M. No. 20785 has lower molars a little broader than in the type, perhaps more noticeable in M_3, but no doubt this is within the range of individual variation.

The last upper molar (U.S.N.M. No. 21281) is considerably larger than that (No. 16697) tentatively assigned to *P. rubeyi* but relatively does not show so marked a posterior extension of the posterolingual portion. It is also less expanded in this respect than in the type material of *P. cookei*. Its measurements are 6.8 mm. anteroposteriorly by 9.8 for the greatest diameter.

MEASUREMENTS IN MILLIMETERS OF LOWER TEETH IN SPECIMENS OF *Plasiadapis cookei*

	U.S.N.M. No. 16698	U.S.N.M. No. 20785
P_3, anteroposterior diameter : transverse diameter...	5.2 : 3.7	
P_4, anteroposterior diameter......................	5.3	
M_1, anteroposterior diameter : transverse diameter of talonid	....	6.1 : 5.6
M_2, anteroposterior diameter : transverse diameter of talonid	6.4 : 5.5	6.4 : 6.3
M_3, anteroposterior diameter : transverse diameter of trigonid	10.5[a] : ...	10.0[a] : 6.2

[a] Approximate.

PLESIADAPIS? PEARCEI,[2] new species

Plate 1, figure 9

Type.—Right ramus of mandible (U.S.N.M. No. 20787), with M_1 and M_2.

Horizon and locality.—Buckman Hollow Clarkforkian Paleocene on La Barge Creek, NW¼NE¼ sec. 12, T.26 N., R.114 W., Lincoln County, Wyo.

Specific characters.—Size close to that of *Plesiadapis dubius*, but trigonids of lower molars narrower and talonids wider than in that species. Apices of cusps on trigonid more widely spaced transversely and entoconid of M_1 and M_2 distinctly more posterolingual in position.

Discussion.—The two lower jaw portions considered to represent this peculiarly distinctive form were at first allocated to *P. rubeyi* but their smaller size coupled with the lingually and backward-jutting entoconid position apparently precludes this possibility. The position of the entoconid gives the talonid of the first two lower molars a relatively marked width in contrast with the narrow trigonid, com-

[2] Named for Franklin L. Pearce who found the type specimen.

pared, for example, with *P. dubius,* which this form approaches in length of lower molars. Moreover, although the trigonid is narrower at its base than in *P. dubius,* the apices of the cusps are more widely spaced transversely, and in M_1 the paraconid is farther forward. In M_2, however, the paraconid is not farther forward with respect to the metaconid than in *P. dubius.*

The peculiarities outlined above tempt speculation on the possibility that an undescribed genus is represented. I believe, however, that the differences here noted are probably of no greater significance than (and quite opposite in general tendency to) the markedly sloping outer walls of lower cheek teeth seen in the *P. jepseni–P. anceps–P. rex* group, presumably no more than subgeneric in importance.

MEASUREMENTS IN MILLIMETERS OF LOWER TEETH IN SPECIMENS OF *Plesiadapis? pearcei*

	U.S.N.M. No. 20787 *Type*	U.S.N.M. No. 20786
M_1, anteroposterior diameter	3.1	3.2
M_1, transverse diameter of trigonid	2.1	2.0
M_1, transverse diameter of talonid	2.5	2.5
M_2, anteroposterior diameter	3.4	...
M_2, transverse diameter of trigonid	2.4	...
M_2, transverse diameter of talonid	2.8	...

CARPOLESTIDAE

CARPOLESTES, cf. DUBIUS Jepsen, 1930

Plate 1, figure 4

A carpolestid P_4 (U.S.N.M. No. 21280) in the collection can be closely matched in size by specimens of *Carpolestes dubius.* The tooth shows a high, uniformly convex crest in lateral view with scarcely discernible vertical ridges. There would appear to be about eight feeble serrations in advance of the position of the heel which is broken away. In lingual view the vertical ridges are a little more visible and the height of the crown is less, but with possibly less difference in height between the two sides than in the Polecat Bench material. The posterior portion of the lingual surface is gently concave, whereas the labial wall is slightly convex in vertical profile. In a dorsal view the crown appears slightly bilobed with the greatest width across the posterior portion. There is no distinct cingulum labially, and lingually a cingulum is perhaps feebly defined posteriorly.

The Almy tooth is distinctly larger and higher crowned than the corresponding tooth in *Carpodaptes hazelae.* It also has a greater number of serrations of smaller size and the associated ridges are less clearly defined. U.S.N.M. No. 21280 is certainly much closer to *Carpolestes dubius* than to any of the other known carpolestids, and it seems, moreover, that *C. dubius* is somewhat more removed from *Carpodaptes* in the form of P_4 than is the genotype *Carpolestes nigridens.*

Carpolestes dubius is recorded by Jepsen (1930) from the Clark Fork beds as well as the Tiffanian portion of the Polecat Bench sequence.

The Almy P_4 measures 2.9 mm. from its anterior margin to the posterior root at the alveolus. The width is approximately 1.8 mm. across the posterior portion of the base of the tooth.

CARNIVORA

ARCTOCYONIDAE

ANACODON? NEXUS,[3] new species

Plate 1, figure 1

Type.—Left ramus of mandible (U.S.N.M. No. 21282) with M_1 and M_2.

Horizon and locality.—Buckman Hollow Clarkforkian Paleocene on La Barge Creek, NW¼NE¼ sec. 12, T.26 N., R.114 W., Lincoln County, Wyo.

Specific characters.—Size considerably smaller than *Anacodon ursidens,* but teeth only slightly larger than in type of *Claenodon montanensis.* Primary cusp pattern of lower molars better defined than in *Anacodon ursidens* or *A. cultridens,* but trigonid less elevated above talonid than in *Claenodon montanensis.* Also, anterior crest from hypoconid low but joins protoconid at a completely lingual position so that inner wall of first two lower molars shows little flexure midway of its length.

Discussion.—*Anacodon? nexus* is considered as possibly representing that genus rather than *Claenodon* as earlier (Gazin, 1956 and in press) supposed, because of the lowness of the trigonid on M_1 as well as M_2. Also the crista obliqua has entirely lost its oblique character or has been overshadowed by the development of a distinctly lateral spur or crest extending forward from the hypoconid to the posterolateral surface of the protoconid, one of the several possibilities afforded by the crenulated character of the principal cusps in the

[3] *nexus* (L.) = tie, bind, with reference to its intermediate position between *Claenodon* and *Anacodon.*

Claenodon line. The result of this is a broadening of the basin of the talonid giving it a rather different appearance than, for example, in *Claenodon montanensis*. Nevertheless, the lower molars have retained clear definition of the principal cusps, showing the *Claenodon* pattern, which is nearly lost in the crenulate character of the more flattened tooth crowns of Eocene *Anacodon*.

The character of the anterior portion of the jaw in *Anacodon? nexus* cannot be determined, nevertheless the reduction of the anterior premolars, the development of a diastema behind the canine, and a flange on the lower jaw below the symphysis characteristic of *Anacodon* has already been anticipated in *Claenodon acrogenius* of the lower Tiffanian in the Bison Basin. However, in *C. acrogenius* the flange is comparatively incipient and the lower canine is enlarged rather than reduced. Moreover, the lower molars of *C. acrogenius,* except for size, would appear to be indistinguishable from those in other species of *Claenodon.* I suspect that the anterior portion of the lower jaw of *Anacodon? nexus* was deepened and exhibited a diastema behind the canine, although this is not certain, and there remains the possibility that *A.? nexus* is a survival of more typical *Claenodon* with shallow symphysis and unreduced premolars, but with the tooth pattern advancing parallel to that leading to *Anacodon.*

M_1 in No. 21282 of *Anacodon? nexus* measures approximately 9.5 mm. in length by 7.8 mm. across the talonid. M_2 is about 10.7 mm. long and 8.5 mm. across the trigonid.

MESONYCHIDAE

DISSACUS, sp.

The upper tooth portion (U.S.N.M. No. 16699) including the protocone and metacone, previously (Gazin, 1942) listed as a "creodont, gen. and sp. undet.," may well be an anterior molar of *Dissacus.* A second tooth fragment, the posterior portion of a lower premolar, possibly P_2 or P_3, also suggests *Dissacus.* These are evidently of a form not greatly different in size from the Torrejonian *Dissacus navajovius,* clearly smaller than *Dissacus praenuntius* Matthew of the Clark Fork beds.

MIACIDAE

DIDYMICTIS?, sp.

A left M_1 may well belong to a species of *Didymictis,* but is very much smaller than contemporary *Didymictis protenus proteus* from the Clarkforkian of the Big Horn Basin. It is only a little smaller than Torrejonian *Didymictis haydenianus,* but not to be compared with *D. microlestes* or *D. tenuis.* Possibly the Almy form is a forerunner of one of the other miacid genera of the Eocene, but the tooth in question is not too well preserved so that detailed comparison is unwarranted.

CONDYLARTHRA

PHENACODONTIDAE

ECTOCION RALSTONENSIS Granger, 1915

Plate 2, figures 1 and 2

Ectocion, though by no means as abundantly represented in number of specimens as *Phenacodus,* has in the material comprising it certainly the best specimen in the Almy collection. The skull and jaws (U.S.N.M. No. 20736) referred to *Ectocion ralstonensis* in general lack only the right and posterior elements of the cranium and the posterior portion of the right ramus of the mandible. The rostrum and left side of the cranium and mandible are comparatively well preserved, though fractured and slightly distorted. The teeth are for the most part in excellent condition and only the upper incisors and P^1 and P^2 of the right side are missing from the skull. The lower jaws have P_3-M_3 preserved in both rami. An incomplete humerus and ulna were found associated with the skull. There are, in addition to this specimen, about 12 others consisting of jaw and maxillary portions and isolated teeth referred to or tentatively identified as *E. ralstonensis* in the Almy collection.

In a lateral aspect the *Ectocion ralstonensis* skull reveals certain details of interest regarding the foramina, so often not ascertainable in Paleocene materials. The anterior opening of the infraorbital foramen is directly above the anterior root of P^3 and well forward of the anterior margin of the orbit. Posteriorly this foramen opens in the orbital cavity at the anterior apex of the large triangular-shaped orbital plate of the maxilla. Superior and somewhat medial to the posterior opening of the infraorbital foramen and separated from it by a backward and medially extending ridge, which may coincide with the sutural ridge of the maxilla, is an aperture believed to be a sphenopalatine foramen. Above this and somewhat lateral to it is the lachrymal foramen, concealed in lateral view by the margin of the orbit.

In the posterior portion of the orbital cavity, the optic foramen is well forward—a little less than a centimeter—of the sphenoidal fissure. About a half centimeter posterolateral and somewhat ventral to the sphenoidal fissure is an aperture which is surely the anterior opening of an alisphenoid canal. The posterior opening is clearly defined well forward and ventromedial to the foramen ovale. I am unable to determine the presence or absence of a foramen rotundum, possibly opening into the alisphenoid canal. According to W. K. Gregory (Orders of Mammals, p. 354), a foramen rotundum opened into the alisphenoid canal in *Phenacodus;* however, Simpson (1933), in describing an endocranial cast of *Phenacodus,* shows both first and second branches of the trigeminal nerve as having passed through the sphenoidal fissure. This would seem to preclude the possibility of a distinctly separate foramen rotundum in *Phenacodus,* which is regarded as closely related to *Ectocion.*

Ventrally, the posterior palatine foramen is about opposite the posterolingual portion of M_1. There is a small, blunt pterygoid process of the maxilla, and opposing it medially is a somewhat everted lateral portion of the anterior margin of the posterior narial aperture. The nasal cavity is closed below posteriorly to a position about even with the posterior margin of the last molar. The previously mentioned posterior opening of the alisphenoid canal faces more ventrally and well ahead of the foramen ovale, a relative distance nearly as great as in *Meniscotherium.* The postglenoid foramen is large and placed posteromedial to the postglenoid process, and the space for the audital tube behind the postglenoid process is shallow and broadly open.

The teeth in U.S.N.M. No. 20736 show the anterior premolars, above and below, to be separated from each other and from the canine by diastemata, the greatest separation being between the first and second premolars, about 4 mm. above and 3 mm. below. The anterior premolars above are simple and 2-rooted, whereas P_1 has but one root.

The essential difference between *Ectocion ralstonensis,* as exemplified by No. 20736, and the *Ectocion osbornianum* material in the U. S. National Museum from the Gray Bull is to be found, in addition to a slightly smaller size of the teeth, in the less progressive character of the posterior premolars of *E. ralstonensis.* The tritocone in both P^3 and P^4 is distinctly less developed and less well separated from the primary cusp. This is particularly noticeable in P^3. Moreover, the anterointernal cusp or protoconule is less developed. It is not present on P^3 and comparatively weak on P^4 of *E. ralstonensis.* In *E. osbornianum* material at hand, the protoconule is generally prominent and may be thrust to a decidedly anterolingual position in both P^3 and P^4. There is no tetartocone on the posterior upper premolars of

No. 20736, but it may be moderately developed on the cingulum of P^4 and sometimes P^3 in *E. osbornianum.*

The lower premolars appear relatively more slender in *Ectocion ralstonensis* than in *E. osbornianum,* and P_4 has a less molariform appearing talonid with, as noted by Granger (1915, p. 353), a much weaker entoconid than usually seen in *E. osbornianum*; also *E. ralstonensis* exhibits a shallower mandible.

Upper and lower molars of *Ectocion ralstonensis* are apparently not distinctive in comparison with *E. osbornianum,* except for the greater average size in the latter. However, comparison with *Gidleyina wyomingensis* (Gazin, 1956) shows that, as earlier stated, the crests from the protocone to the protoconule and metaconule of the upper molars are better defined in the latter. Moreover, in some specimens of *Gidleyina wyomingensis* and in the types of *G. silberlingi* and *G. superior* the parastylid crest of the lower molars tends to join the metaconid, suggestive of *Phenacodus.* As noted by Granger, the parastylid crest of *Ectocion,* as far as observed, is separate from the metaconid in the lower molars.

MEASUREMENTS IN MILLIMETERS OF DENTITION IN SPECIMEN OF *Ectocion ralstonensis,* U.S.N.M. NO. 20736

Length of upper dentition from anterior margin of canine (at alveolus) to posterior margin of M^3	49.7
Length of upper cheek tooth series, P^1-M^3, inclusive	41.8
Length of upper premolar series, P^1-P^4, inclusive	24.0
Length of upper molar series, M^1-M^3, inclusive	18.0
C, anteroposterior diameter at alveolus : transverse diameter at alveolus	4.1 : 2.8
P^1, anteroposterior diameter : transverse diameter	3.0 : 1.5
P^2, anteroposterior diameter : transverse diameter	4.0 : 2.2
P^3, anteroposterior diameter : transverse diameter	5.7 : 5.5
P^4, anteroposterior diameter : transverse diameter	6.0 : 7.3
M^1, anteroposterior diameter : transverse diameter across anterior portion	6.2 : 8.5
M^2, anteroposterior diameter : transverse diameter across anterior portion	6.2 : 9.1
M^3, anteroposterior diameter : greatest transverse diameter	4.9 : 7.5
Length of lower cheek tooth series P_1 (at alveolus)-M_3, inclusive	42.8
Length of lower premolar series, P_1 (at alveolus)-P_4, inclusive	23.3
Length of lower molar series, M_1-M_3, inclusive	20.0
P_3, anteroposterior diameter : transverse diameter	5.5 : 3.2
P_4, anteroposterior diameter : transverse diameter	6.7 : 4.1
M_1, anteroposterior diameter : transverse diameter of talonid	6.5 : 5.1
M_2, anteroposterior diameter : transverse diameter of trigonid	6.5 : 5.4
M_3, anteroposterior diameter : transverse diameter of trigonid	6.7 : 4.5

ECTOCION, cf. OSBORNIANUM (Cope), 1882

A right lower jaw fragment with P_4-M_2 (U.S.N.M. No. 20645) has teeth more robust than in the jaw belonging to the *E. ralstonensis* skull, and in addition P_4 is more progressive with a better developed talonid basin and a large entoconid. P_4, moreover, has a rather distinctly developed paraconid or parastylid. This specimen is tentatively regarded as representing the Gray Bull species *E. osbornianum.* There are in addition three other jaw fragments, each with a comparatively large molar which may likewise be referred.

Although Granger (1915) recognized three species of *Ectocion* in the Clark Fork beds, including both *E. ralstonensis* and *E. osbornianum,* Simpson (1937b), in his treatment of the material, believed (except for rare *E. parvus*) that a single species was represented in which there was a shift in the mean size, the length of M_1 for example, between successive horizons from Clark Fork to Lost Cabin time. While this seems evident in the demonstration given, I am, nevertheless, concerned about the more progressive P_4 in the larger Almy specimen. The character of P_4 might likewise show marked variation within a species, but there are three small-toothed or *E. ralstonensis* specimens which have P_4 preserved, and in each of these this tooth is distinctly less progressive. The correlation may be a coincidence, but if not, I am inclined to believe that in this instance a distinct species is actually represented.

MEASUREMENTS IN MILLIMETERS OF TEETH IN THE SPECIMEN OF *Ectocion,* cf. *osbornianum,* U.S.N.M. NO. 20645

P_4, anteroposterior diameter : transverse diameter of talonid	7.5 : 5.1
M_1, anteroposterior diameter : transverse diameter of trigonid	6.8 : 5.9
M_2, anteroposterior diameter : transverse diameter of trigonid	7.1 : 6.5

PHENACODUS ALMIENSIS Gazin, 1942

Plate 2, figures 3 and 4

A relatively small species of *Phenacodus, P. almiensis,* is clearly the most abundantly represented form in the fauna. The 32 specimens in the collection referred to it comprise about 44 percent of the total. The type specimen, U.S.N.M. No. 16691, consists of maxillae with the canines and P^3 to M^3 in a scarcely worn state, together with certain limb and vertebral portions. Although collected in 1941, it remains after six subsequent collecting trips the best specimen of this species extant.

P. almiensis is much smaller than *Phenacodus p. intermedius* but appreciably larger than *P. copei*. It differs essentially from the *Phenacodus primaevus* group, other than in size, in better developed external styles, particularly the parastyle, and in exhibiting slightly more crescentic cusps. The protocone in the upper molars, for example, is united by better defined crests to the protoconule and metaconule and generally with the hypocone as well. The metaconule is about on a line between the metacone and hypocone, not posterior to this, as frequently observed in *P. primaevus,* nor so forward as in *Ectocion.*

P. almiensis is significantly larger than any of the *P. copei* material observed, and although the latter exhibits fairly prominent external styles on the upper molars, the cusps, particularly the protocone, have less developed crests than in *P. almiensis.* Granger (1915) noted that the metaconules were weak or absent in *P. copei.* These are apparently not reduced in *P. almiensis.* Moreover, the upper premolars, strangely enough, appear more advanced than in *P. copei.* P^3 has a well-defined and separate tritocone, described as weak in *P. copei,* and this tooth in *P. almiensis* also has incipient to clearly defined conules and tetartocone. P^4 is distinctly molariform in appearance, and is recognized among isolated teeth by the absence of a mesostyle and by the somewhat less developed, though by no means weak, hypocone (or tetartocone, in upper premolar nomenclature). Both conules are present and well defined.

Compared to earlier species, *P. almiensis* is distinctly larger than *P. matthewi,* as well as *P. gidleyi,* and not nearly so robust as *P. grangeri* among the species known from the Colorado Tiffany. Moreover, the teeth are relatively not so broad transversely as in *P. grangeri.* The premolars are decidedly more advanced than in *Phenacodus bisonensis.*

As noted earlier (Gazin, 1942), the teeth of *P. almiensis* show some resemblance to *Ectocion* in the development of the external styles and somewhat crescentic appearance of the cusps; however, I do not believe that *Ectocion* is represented because of the markedly elongate (anteroposteriorly) and relatively narrow upper molars, the position of the metaconule, and the comparatively unreduced condition of the hypocone of M^3. Also, in the lower molars the anterior crest joins both the protoconid and metaconid, and the hypoconulid is not so close to the entoconid as it usually is in *Ectocion.*

MEASUREMENTS OF UPPER TEETH IN SPECIMENS OF
Phenacodus almiensis

	U.S.N.M. No. 16691 *Type*	U.S.N.M. No. 21286
Length of cheek tooth series, P^3-M^3, inclusive	42.7[a]	41.0[a]
Length of molar series, M^1-M^3, inclusive	26.1[a]	26.7
P^3, anteroposterior diameter : transverse diameter	8.2 : 7.4	7.7[a] : 8.6
P^4, anteroposterior diameter : transverse diameter	8.5 : 8.5	7.9 : 9.2
M^1, anteroposterior diameter : transverse diameter *	9.0 : 10.0	9.0 : 11.0[a]
M^2, anteroposterior diameter : transverse diameter *	9.2 : 11.3	8.8 : 12.5[a]
M^3, anteroposterior diameter : transverse diameter *	7.7 : 10.8	8.7[a] : 10.5[a]

[a] Approximate.

* Anteroposterior diameter of upper molars taken perpendicular to anterior margin and transverse diameter across anterior portion.

PHENACODUS PRIMAEVUS Cope, 1873

Plate 2, figure 5

Two specimens in the collection may well represent typical *Phenacodus primaevus.* One of these, U.S.N.M. No. 21287, is a lower jaw with P_3 to M_2, inclusive, and the other an incomplete lower molar. The teeth in No. 21287 are comparable in size to those in the Clark Fork material referred to *P. primaevus.* The length of the lower molars is near the lower limit of the range given for each (Simpson, 1937b, p. 18) and the widths are nearer the upper limit, suggesting relatively broad teeth, not otherwise distinguished from *P. primaevus.*

About eight specimens of smaller size, though not comparable to *P. almiensis,* correspond in general proportions to Gray Bull materials earlier regarded as *Phenacodus intermedius.* The dimensions of teeth in one of these (U.S.N.M. No. 20644), evidently the largest of the group, are given in the accompanying table. In this and others having comparable lower molars the teeth are observed to be relatively slender, particularly in comparison with the larger, broad-toothed form discussed above. A single specimen encountered by Simpson (1937b, p. 19) in the Clark Fork collections, representing a smaller group which approximates the intermediate-sized form in the Almy fauna, was regarded by him as *Phenacodus primaevus,* small var., cf. *intermedius.* The Almy materials may be treated in a similar manner, for taxonomic convenience, because, although the limited Almy materials might appear to be clearly defined, I find it difficult to distinguish *P. intermedius* from *P. primaevus* in the Gray Bull collections. Nevertheless, I feel rather strongly opposed to a concept which recognizes more than one subspecies of the same form coexisting in time and at the same geographic locality.

MEASUREMENTS IN MILLIMETERS OF CERTAIN LOWER TEETH IN JAWS OF *Phenacodus*

	P. almiensis U.S.N.M. No. 20643	*P. p.*, cf. *intermedius* U.S.N.M. No. 20644	*P. p. primaevus* U.S.N.M. No. 21287
P_4, anteroposterior diameter	9.6	11.5	12.7
P_4, transverse diameter of talonid.....	6.2	7.8	10.2
M_1, anteroposterior diameter.........	9.1	11.8	12.1
M_1, transverse diameter of talonid....	7.4	9.8	11.2
M_2, anteroposterior diameter	...	....	12.5[a]
M_2, transverse diameter of trigonid....	...	....	12.5

[a] Approximate.

DINOCERATA

UINTATHERIIDAE

PROBATHYOPSIS?, sp.

Plate 1, figures 2 and 3

Two upper premolars, possibly both P^3, or P^3 and P^4, but of different individuals as indicated by wear, are evidently of *Probathyopsis*. They are, however, significantly larger than *Probathyopsis praecursor* Simpson (1929) of the Clark Fork beds. They correspond closely in size to a P^3 belonging with a partial skeleton of cf. *Bathyopsis fissidens* Cope from the New Fork upper Wasatchian (Gazin, 1952, p. 64), but are slightly more brachydont. The unworn Almy premolar (U.S.N.M. No. 21283) measures 14.6 mm. long perpendicular to anterior margin by 16.5 mm. wide perpendicular to outer wall. P^3 in the type of *P. praecursor* measures 11.5 by 13.3 mm. in the same directions.

The proportions of the upper premolars are comparable to those of the earlier *Bathyopsoides harrisorum* Patterson (1939) from the Plateau Valley beds, although the unworn Almy premolar is a little shorter anteroposteriorly and broader transversely than the *B. harrisorum* P^3. Nevertheless, the transverse lophs have about the same proportions. Although Patterson has indicated certain differences in cusp pattern of M_2, it would seem from the evidence presented by Dorr (1952, p. 89) that *Bathyopsoides* is possibly a male *Probathyopsis*. Better evidence with regard to this situation should be forthcoming in the more detailed study of the Hoback Basin material contemplated by Dorr.

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EXPLANATION OF PLATES

Plate 1

PRIMATES, ANACODON?, AND PROBATHYOPSIS? FROM THE ALMY PALEOCENE

Fig. 1. *Anacodon? nexus,* new species: M_1 and M_2 (U.S.N.M. No. 21282), type specimen, occlusal view. Natural size.

Figs. 2 and 3. *Probathyopsis?,* sp.: 2, Upper premolar (U.S.N.M. No. 21283), occlusal view; 3, upper premolar (U.S.N.M. No 21284), occlusal view. Natural size.

Fig. 4. *Carpolestes,* cf. *dubius* Jepsen: P_4 (U.S.N.M. No. 21280), labial (left) and lingual views. Six times natural size.

Figs. 5-8. *Plesiadapis cookei* Jepsen: 5 and 7, Left ramus of mandible (U.S.N.M. No. 20785), (5) occlusal view, twice natural size, and (7) lateral view, natural size; 6 and 8, left ramus of mandible (U.S.N.M. No. 16698), (6) occlusal view, twice natural size, and (8) lateral view, natural size.

Fig. 9. *Plesiadapis? pearcei,* new species: Right ramus of mandible (U.S.N.M. No. 20787), type specimen, occlusal and lingual views. Three times natural size.

Fig. 10. *Plesiadapis rubeyi* Gazin: Right ramus of mandible (U.S.N.M. No. 16696), type specimen, occlusal and lingual views. Three times natural size.

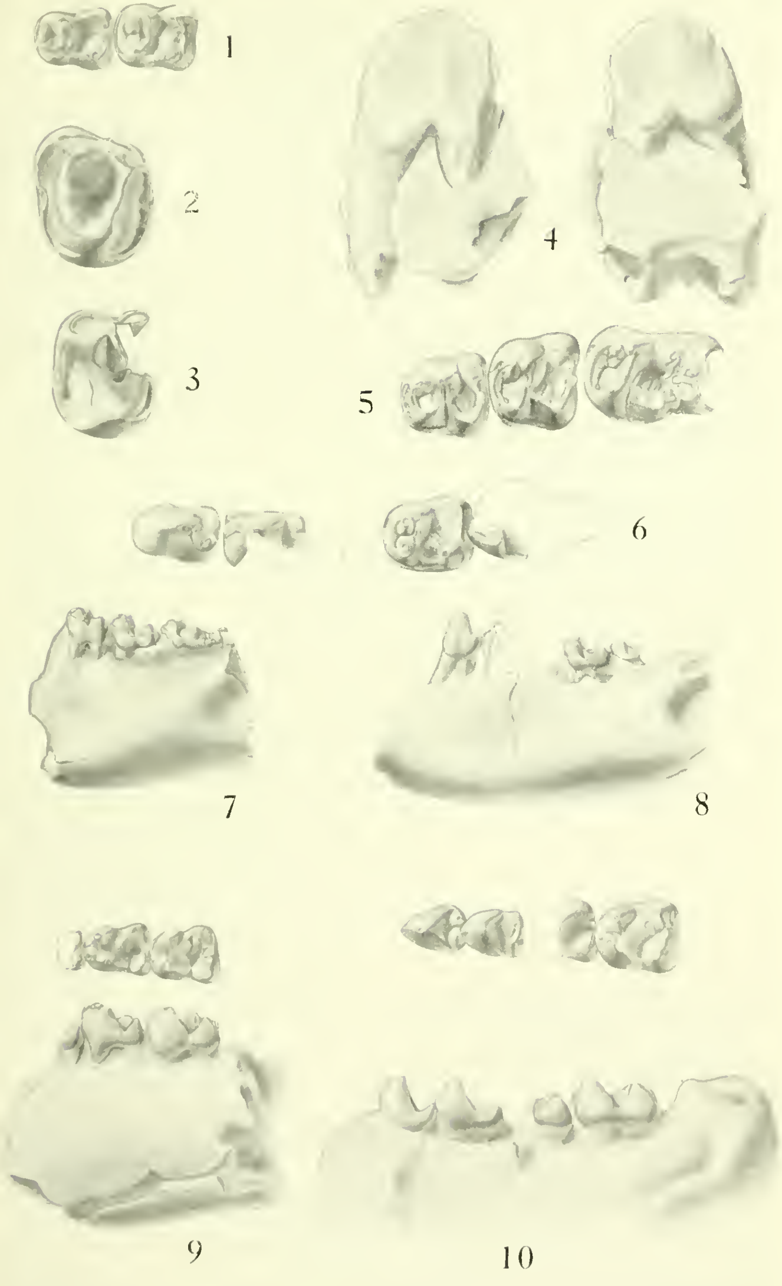
Plate 2

CONDYLARTHS FROM THE ALMY PALEOCENE

Figs. 1 and 2. *Ectocion ralstonensis* Granger: 1, Skull (U.S.N.M., No. 20736), lateral and ventral views. Natural size; 2, left ramus of mandible (U.S.N.M. No. 20736), lateral and occlusal views (M_1 restored from right side). Natural size.

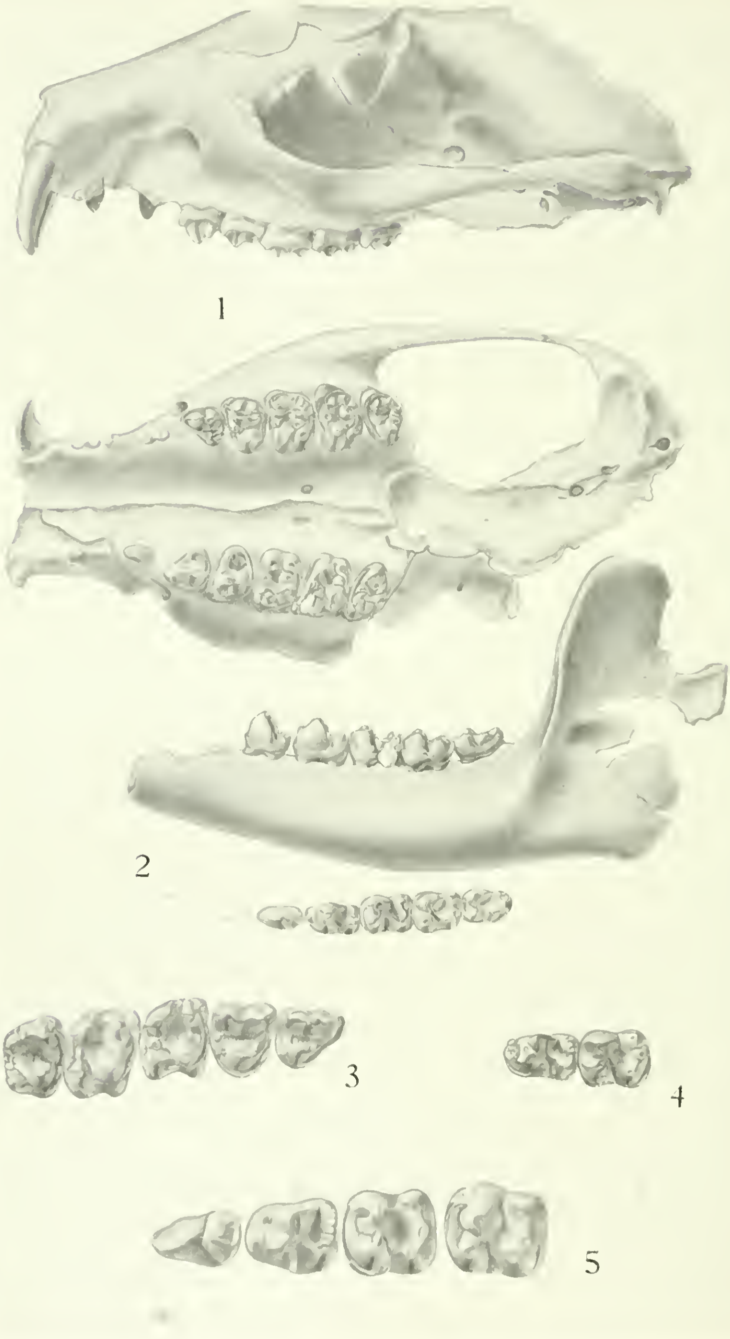
Figs. 3 and 4. *Phenacodus almiensis* Gazin: 3, Right upper cheek tooth series (U.S.N.M. No. 16691), type specimens, occlusal view (M^2 restored from left side); 4, left ramus of mandible (U.S.N.M. No. 20643), occlusal view. Natural size.

Fig. 5. *Phenacodus primaevus* Cope: Left ramus of mandible (U.S.N.M. No. 21287), occlusal view. Natural size.



PRIMATES, ANACODON?, AND PROBATHYOPSIS? FROM THE ALMY PALEOCENE

(SEE EXPLANATION AT END OF TEXT.)



CONDYLARTHS FROM THE ALMY PALEOCENE

(SEE EXPLANATION AT END OF TEXT.)