

the Permian of the United States.* It is not improbable that such occurrence of genera may yet be substantiated, but the identification of an order hitherto unknown in a formation, on uncertain characters, is not a safe proceeding. The vertebræ of *Leptophractus* although not certainly known, are supposed to be of the Labyrinthodont type. The teeth are much more compressed and trenchant than in the present species, nor do there appear to be any long ones near the symphysis mandibuli. I consider the question of reference to *Leptophractus* to be still an open one.

The family *Eryopidæ*, though abundant in individuals, is not represented by many species. They are presumably as follows :

Anisodexis imbricarius Cope.

Acheloma cumminsi Cope.

Eryops reticulatus Cope.

Eryops ferricolus Cope (*Parioxys olim*).

Eryops megacephalus Cope.

Actinodon frossardi Gaudry.

Zatrachys serratus Cope.

Zatrachys apicalis Cope.

But the occipital condyles are unknown in *Acheloma* and *Zatrachys*.

I may add here that through the courtesy of Messrs. Scott and Osborne, I have seen, in the Museum of Princeton College, vertebræ of some species of the Rhachitomi from Saarbrücken, along with *Archegosaurus*, with entire centra, from the same locality.

Synopsis of the Vertebrata of the Puerco Eocene epoch. By E. D. Cope.

(Read before the American Philosophical Society, October 20, 1882.)

REPTILIA.

CROCODILIA.

Crocodylus sp.

Crocodylus sp.

Crocodylus sp.

TESTUDINATA.

Plastomenus ? communis Cope.

Dermatemys sp.

Compsemys sp.

Emys sp.

* *Peplorhina arctata* Cope, from the Illinois Permian, is not a *Peplorhina*, but a Theromorph Saurian.

CHORISTODERA.

Champsosaurus australis Cope, American Naturalist, 1881, p. 690.

Champsosaurus puercensis Cope, Proceedings American Philosophical Society, 1881, p. 195.

Champsosaurus saponensis Cope, Loc. cit. 1881, p. 196.

MAMMALIA.

MARSUPIALIA.

Ptilodus mediaevus Cope, American Naturalist, 1881, p. 922.

Ptilodus trovessartianus Cope, loc. cit. 1882, p. 686.

Catopsalis foliatus Cope, loc. cit. 1882, p. 416.

Catopsalis pollux Cope, loc. cit. 1882, p. 685.

Polymastodon taöensis Cope, loc. cit. 1882, p. 684.

BUNOTHERIA.

TAENIODONTA.

Hemiganus vultuosus Cope, loc. cit. 1882, p. 831.

Tæniolabis scalper Cope, loc. cit. 1882, p. 604.

TILLODONTA.

Psittacotherium multifragum Cope, l. c., 1882 p. 156.

Psittacotherium aspasiæ Cope, Proceed. Amer. Philosophical Society, 1882, p. 192, (1882).

MESODONTA.

Pelycodus pelvidens Cope, Proceeds. Amer. Philos. Soc. 1881, (1882) p. 151. *Lipodectes pelvidens* Cope, American Naturalist. 1881, p. 1019.

Hyopsodus acolytus Cope, sp. nov.

This the least species of the genus, is also the oldest, being derived from the Puerco horizon. Parts of two individuals furnish the characters of the inferior and superior true molars, and the fourth superior premolars. The species differs from those hitherto described in other characters than the minute size. One of these is the absence of posterior interior cusp, the heels of the first and second true inferior molars being bounded by a ridge only at this point, as in most of the species of *Pelycodus*. The last inferior molar is not smaller than the second, nor longer. The anterior cusps of all the molars are robust, so that on the first and second true molars they are separated by a shallow notch only. There is a rudiment of the anterior inner cusp on the first true molar but none on the second and third. The posterior external is obtuse and has a triangular section on all the molars; a crest is continued from the heel of the third molar on the inner side of the crown half way to the anterior inner cusp.

The *Microsyops spierianus* differs from this species in its smaller size (true molars .008) and in the presence of posterior internal cusps of the true molars.

The *Hyopsodus acolytus* was found by Mr. D. Baldwin, in New Mexico.

CREODONTA.

Sarcothraustes antiquus Cope, Proceeds. Amer. Philos. Soc. 1881 (1882), p. 193.

Dissacus carnifex Cope, Amer. Natst. Oct. 1882 (Sept.), p. 834.

Dissacus navajovius Cope, loc. cit. 1881, p. 1019. *Mesonyx navajovius* Cope, Proceeds. Amer. Philos. Society, 1881, p. 484.

Triisodon quivirensis Cope Amer. Nat. 1881, p. 667.

Triisodon heilprinianus Cope, Proceeds. Amer. Philos. Soc. 1881 (1882), p. 193. •

Deltatherium fundaminis Cope, Amer. Nat. 1881, p. 237; 1881, p. 337.

Lipodectes penetrans, loc. cit. 1881, p. 1019.

Deltatherium baldwini Cope.

This Creodont is known only from a portion of a right mandibular ramus which supports the two last premolars, and the first true molar with part of the second. It differs from the *D. fundaminis* in its materially smaller size, and in the forms of the teeth. The first true molar is a more robust tooth, and the basis of the posterior or heel crest is more rounded, and less angulate. The anterior inner cusp projects less anteriorly. The fourth premolar has a distinct anterior basal lobe which is wanting in the *D. fundaminis*. Its heel is short and wide, and the posterior face of the principal cusp is flat, and there is a rudiment of an internal tubercle on its side. The second premolar is elevated and acute, has no anterior basal lobe, and has a very short wide heel, enamel slightly roughened. The animal was rather aged.

Measurements.

M.

Length of P-m. ii and iii and M. ii.....	.0160
Diameters M. i { anteroposterior.	.0058
transverse.	.0040
Elevation of crown of P-m. iii.....	.0052
Depth of mandible at M. i.....	.0180

From the Puerco beds of N. W. New Mexico. Dedicated to Mr. D. Baldwin, the discoverer of the Mammalian Fauna of the Puerco beds, which is one of the most important in the history of American Palæontology.

Deltatherium interruptum Cope.

The smallest species of *Deltatherium* is, like the *D. baldwini*, only represented by the anterior part of a right mandibular ramus, which supports the last premolar and the first true molar, with the bases of the other pre-

molars and part of the canine. The canine is small and the first premolar in accordance with the generic character, is wanting. The second premolar is two-rooted. The fourth has an elevated principal cusp, and a narrow heel on the inner side of the posterior base; anterior base injured. The first true molar has very little sectorial character, and resembles the corresponding tooth of a *Pelycodus*. It differs entirely from that of the *D. fundaminis* in the possession of a well marked posterior internal cusp, which is connected by a ridge with the large internal lateral cusp of the heel. The anterior cusps of opposite sides sub-equal. A weak external basal cingulum on the anterior half of the crown; no internal cingulum. Enamel of the tooth wrinkled.

Measurements.		M.
Length of premolar series.....		.0140
Elevation of P-m. iv.....		.0040
Diameters of M. i {	antero posterior.....	.0055
	transverse.....	.0042
Depth of ramus at P-m. i.....		.0090
“ “ M.....		.0113

On comparison with the *D. fundaminis*, the first molar tooth has the same dimensions, but the premolars are considerably smaller. The ramus is also shallower. Found by Mr. Baldwin in the Puerco beds of Northwest New Mexico.

Didymictis haydenianus, sp. nov.

This creodont is represented by parts of the maxillary and mandibular bones of the left side, the former supporting the four, and the latter supporting the three last molars. The arrangement of the superior molars is much as in *D. protenus*, the fourth premolar being a true sectorial. The third premolar has no internal lobe, although the section of the base of the crown is narrowly triangular. It has anterior and posterior basal lobes, and a posterior lobe on the cutting edge. In the sectorial the median lobe is a good deal more produced than the posterior, though the two form together the usual blade. The anterior basal lobe is distinct; and the internal is larger and is conic. The first true molar has the anterior external base of the crown produced. Its two external cusps are conic and distinct. The internal part of the crown is rounded and supports a conic internal tubercle, which is separated from the external cones by two small concentric tubercles. The second true molar is considerably smaller, and is transverse, its external border being very oblique. It has an acute internal lobe.

The character of the species is well-marked in the inferior true molars. The first has the form seen in other species of *Didymictis*. The heel is large, and with a median basin between lateral cutting edges. The two anterior inner cusps are of equal elevation and are near together; the external is much larger. The last molar is elongate, but reduced in size. Its anterior three cusps, rudimental in other species, are here elevated, forming the triangular mass seen in the first true molar. They are not so

elevated, however, as in that tooth, and thus not so much developed as in *Oxyæna*, *Stypolophus*, etc. The fourth premolar has a median cutting edge on the short heel.

<i>Measurements.</i>		<i>M.</i>
Length last four superior molars		.022
“ P-m. iii.		.0065
“ “ iv.		.0085
Width “ “		.0050
Diameters M. i	{ anteroposterior.....	.0055
	{ transverse.....	.0088
	{ oblique external.....	.0072
Diameters M. ii	{ anteroposterior.....	.0027
	{ transverse.....	.0055
Diameters inferior M. I	{ anteroposterior.....	.007
	{ transverse.....	.005
Diameters inferior M. II	{ anteroposterior.....	.0055
	{ transverse.....	.003
Depth of ramus at M. II, (squeezed).....		.010

The peculiar characters of the last inferior molar distinguish this species from its congeners. The last superior molar is relatively smaller than in the *D. protenus*. In size this species is superior to the *D. dawkinsianus*, and is smaller than the *D. leptomytus*. It is dedicated to the distinguished geologist, Dr. F. V. Hayden.

New Mexico, D. Baldwin.

TAXEOPODA.

CONDYLARTHRA.

Periptychidæ.

Periptychus rhabdodon Cope. *Catathlæus rhabdodon*, American Naturalist, 1881, 829.

Periptychus carinidens Cope, loc. cit. 1881, p. 337.

Periptychus ditrigonus Cope, sp. nov.

This rare species is known from a right mandibular ramus, which exhibits part of the symphyseal suture, with the alveoli of the molar teeth, except the first. The only well preserved crown is that of the second true molar.

The second true molar presents very peculiar characters, and the mandibular ramus is shallower and thicker than in the two other species of *Periptychus*. The former has a wide external cingulum which is not present in the other species, and there are only six cusps instead of seven. These are peculiarly arranged. The anterior three are much as in *P. rhabdodon*, the anterior being not quite so far internal as the posterior inner, close to it, and as large as the anterior external. The posterior three, are a posterior inner and posterior median as in *P. rhabdodon*, and a peculiarly placed posterior external. This is not

opposite the posterior inner, but is anterior to such a position and intermediate between the latter point, and the one occupied by the median tubercle in *P. rhabdodon*. It is as large as the anterior external tubercle. All these tubercles are conical, and not connected by angles or ridges. The posterior external cusp leaves the cingulum wide posteriorly, and its edge develops some small tubercles. There are also some small tubercles at other points on the edge of the crown, but no other cingula. The enamel is not regularly ridged as in *P. rhabdodon*, but has a rather coarse obsolete wrinkling.

Measurements.		M.
Length from P-m. ii to M ii inclusive.....		.052
Diameters of M. ii {	anteroposterior.....	.011
	transverse.....	.010
Depth of ramus at M. ii.....		.022
Width of " "		.016
Depth of " " P-m. ii.....		.019

From the Puerco formation of New Mexico, D. Baldwin, discoverer.

Haploconus lineatus Cope, Amer. Nat. 1882, p. 417.

Haploconus angustus Cope, Loc. cit. 1882, p. 418. *Mioclanus angustus* Cope, loc. cit. 1881, p. 831.

Haploconus xiphodon, sp. nov.

This species is represented by a mandibular ramus, and perhaps by three rami. The one on which the species rests contains five molars, the middle one of the series broken, so that its form cannot be positively ascertained. It is probable that it is the first true molar, so that the animal exhibits the last true molar not entirely protruded, and is therefore nearly adult, but there are some reasons for suspecting it to be young. Thus the last inferior molar does not exhibit more of a heel than the second usually does, and the third supposed premolar is smaller than that tooth is in the other species, having nearly the proportions of the second premolar. The teeth present may then be supposed to be the molars from the second to the sixth inclusive. But opposed to this view is the fact that the supposed third premolar has more the structure of that tooth in details, than that of the second, and the specimens accompanying, which have the temporary dentition apparently of the same species, present premolar teeth of a very different character. In any case the present specimen represents a third species of the genus, and I describe it at present as an adult.

The third premolar has a simple compressed crown, about as high as the length of its base, and without anterior basal tubercle. It has a narrow triangular posterior face which is concave, and truncated by a cingulum below; no heel proper, nor lateral cingula. The fourth premolar is an elongate tooth consisting of a compressed principal median lobe, an anterior lobe connected with it, and a heel. The latter has elevated posterior and interior borders. A rudiment of an exterior border is seen in a narrow

ridge on the external side of the posterior face of the principal lobe of the tooth.

The sides of the premolars present rather distinct ridges, as in *Periptychus carinidens*. The second true molar has two anterior and three posterior tubercles; the latter close together, pointed and of about equal size. Of the anterior tubercles, the external is much the larger and more elevated. It is compressed and has a curved subacute anterior edge, which extends much in front of the internal tubercle. There is no anterior inner tubercle, nor are there any cingula. The enamel of the sides of the crown presents a few vertical ridges. The last inferior molar only differs from the second, in the greater size of the median posterior lobe, which is nevertheless smaller than in the two other species of *Haploconus*.

There is a mental foramen below the posterior edge of the second inferior premolar.

<i>Measurements.</i>	<i>M.</i>
Length of last five inferior molars.....	.0250
“ third premolar.....	.0050
“ fourth premolar.....	.0066
“ second true molar.....	.0050
Width of second true molar.....	.0032
Length of third true molar.....	.0050
Depth of ramus at P-m. iii.....	.0095
“ “ M. iii.....	.0130

The two rami with the temporary premolars, exhibit the last true molar enclosed in the jaw. The third and fourth premolars are much like the fourth premolar of the specimen above described, but the fourth is a little more robust than that of the latter, which is very much like the third of the deciduous series. The space occupied by the supposed first premolar of the type specimen is too short for the fourth premolar of the deciduous series, otherwise it might be supposed to have occupied that position. The two true molars resemble those of the type, excepting that the last one does not extend so far into the base of the coronoid process, and is in accordance with the position as number two in the series.

The specimens were procured by Mr. D. Baldwin in the Puerco beds of New Mexico.

Haploconus entoconus Cope, loc. cit. 1882, p. 686.

Anisonchus coniferus Cope, loc. cit. 1882, October (September), p. 832.

Anisonchus gillianus Cope. *Haploconus gillianus* Cope, loc. cit., 1882, p. 686.

Anisonchus sectorius Cope, Proc. Amer. Philos. Soc. 1881, p. 488, *Mioclaenus sectorius*, Amer. Nat. 1881, p. 831.

Hemithlaeus kowalevskianus Cope, Amer. Nat. 1882, p. 832.

Hemithlaeus opisthacus Cope. *Mioclaenus opisthacus*, 1 c. 1882, p. 833.

Conoryctes comma Cope American Naturalist, 1881, p. 829.

Conoryctes crassicuspis Cope.

The posterior part of a mandibular ramus supporting the last two molar teeth indicates a second and larger species of the genus. The ramus is one-half deeper than that of the *C. comma*, and the second true molar is much larger than in that species. The last true molar is much smaller than the penultimate, and consists of three anterior cusps and a longer heel. The former are obtuse, the external the longer, the internal equal, the anterior on the inner edge of the crown. The heel sustains a low conic tubercle.

From the Puerco beds of N. W. New Mexico.

Phenacodontidæ.

Protogonia plicifera Cope, Amer. Nat. 1882, Oct. (Sept.), p. 833.

Protogonia subquadrata Cope, Proceedings Amer. Philos. Soc. 1881, p. 492

Phenacodus puercensis Cope, Proc. Amer. Philos. Soc. 1881, p. 492.

Phenacodus zuniensis Cope, loc. cit. p. 492 ; loc. cit. 1881 (1882), p. 180.

Pantolambda bathmodon Cope, Amer. Nat. 1882, p. 418.

Miocænus turgidus Cope, Amer. Nat. 1881, p. 830.

Miocænus minimus, sp. nov.

This is one of the least mammalia of the Puerco fauna, exceeding by a little the *Hyopsodus acolytus*. It is represented by parts of two mandibles, which display all the true molars. As there are no premolars preserved, its reference to the genus *Miocænus* is provisional only, but its true molars have the peculiar characteristics of those of the *M. turgidus*.

The two anterior cusps of the true molars are higher than the heel, and they are united together to a point above the level of the heel. The section of both those of the M. ii is round ; that of the external one of the first is crescentic ; of the inner cusp, round. The heel is wide, and supports a cusp at the posterior external angle. It is bounded posteriorly, and on the inner side by a raised ridge, which gives with the cusp, on wearing a comma-shaped surface. A transverse ridge closely appressed to the anterior cusps connects them anteriorly. In one of the specimens there is a cingulum on the external side of the second inferior molar ; on the other specimen it is wanting. Enamel smooth.

The mandibular ramus is rather deep and compressed, and displays an external ridge on the anterior border of the coronoid, which is not continued downwards.

Measurements (No. 2).

	M.
Length of basis of true molars	.0125
Diameters M. ii { anteroposterior	.0040
{ transverse	.0035
Depth of ramus at M. ii	.0073

From the Puerco beds of New Mexico. D. Baldwin.

Miocænus subtrigonus Cope, Amer. Nat. 1881, p. 490, 491.

Miocænus protogonioides Cope, loc. cit. 1882, Oct. (Sept.), p. 833.

Miocænus mandibularis Cope, Amer. Nat. 1881, p. 830.

Miocænus baldwini Cope, loc. cit. 1882, Oct. p. 833.

GENERAL REMARKS.

The preceding list of fifty-six species is doubtless sufficiently characteristic to enable us to form a pretty good idea of the Puerco fauna. Omitting six undetermined species of reptiles, we find the following peculiarities in the remaining forms. As already pointed out the three determined species of reptiles belong to a suborder, which has thus far been only found in the Laramie formation, or Cretaceous No. 6. This gives the Puerco at once a position below all the other tertiaries. The mutilate orders of mammals may be dismissed as being not likely to occur in a lacustrine formation. The orders of land Mammals are represented as follows :

Monotremata.....	0
Marsupialia.....	5
Rodentia.....	0
Chiroptera.....	0
Edentata.....	0
Bunotheria.....	15
Tæniodonta.....	2
Tillodonta.....	2
Insectivora.....	0
Mesodonta.....	2
Lemuroidea.....	0
Creodonta.....	9
Taxeopoda.....	25
Hyracoidea.....	0
Condylarthra.....	25
Proboscidea.....	0
Amblypoda.....	0
Diplarthra.....	0
Carnivora.....	0
Quadrumania.....	0
Total.....	45

The above list renders the peculiar facies of this fauna at once apparent. It is the only Tertiary fauna known, from which Perissodactyla are absent. The absence of Amblypoda, one of the oldest types, is unexpected. The lack of Rodentia is remarkable, and perhaps only due to failure of discovery ; but if yet to be found, they must be very rare, and their absence is consistent with their small representation in the Wasatch beds above them. In the large number of Bunotheria, the Puerco agrees with the later Eocenes, but the order is here characterized by the small number of Mesodonta ; and the Lemuroidea are apparently absent. An especial feature of the fauna is the presence of five undoubted species of Marsupialia of the family Plagiaulacidae, which has its origin in the Jurassic

period, and extended through the Cretaceous. It is represented in the latter period in the Laramie by the genus *Meniscoëssus*.*

In the absence of a number of the existing orders of placental Mammalia, the Puerco agrees with other Eocene faunæ. In the absence of all of the placental orders with convoluted cerebral hemispheres, this fauna is more primitive than any other Eocene fauna. The absence of all ungulata excepting Taxeopoda, which have the most primitive foot structure, is further evidence of its primitive character. This is further increased by the presence of the Marsupialia above mentioned. The general result is a mixture of Marsupial, and semi-marsupial forms, with half lemurs, and a great expansion of the Hyracoid type.

In more detail, the genera of Bunotheria may be compared with those of the period immediately following; viz.: The Wasatch. One genus only of the Creodonta is common to the two epochs (*Didymictis*). Five of the species remaining are much like opossums, and may be Marsupialia. The two genera (*Deltatherium* and *Triisodon*) to which they belong, do not occur in the Wasatch. The remaining two genera, (three species) are peculiar to the Puerco, but represent a family (Mesonychidæ) which occurs throughout our Eocenes. The two species of Mesodonta belong to genera of the Wasatch, one of them at least extending into the Bridger. The genera of Tæniodonta and Tillodonta are distinct from those of any of the later Eocenes, so far as known.

Supplement on a new Meniscotherium from the Wasatch epoch.

Meniscotherium tapiacitis, sp. nov.

The species now to be described is a good deal smaller than *M. chamense*, and, *a fortiori*, than the *M. terrærubræ*. It is known to me from the nearly entire rami of a single mandible. These support the last five molars of one side or the other, and alveoli of two others and of the canine tooth.

Two characters besides the small size, are observable in this jaw. First, the symphysis has not the shallow convex inferior outline in transverse section; but is on the contrary angular, having subvertical sides separated from a convex middle by a rounded angle. The symphysis is thus deeper than in *M. terrærubræ*. Second, the crown of the third inferior molar tooth has partly the form of that of the second of the *M. terrærubræ*. It is antero-posteriorly short, and has a short heel and no anterior basal lobe; the section of the principal lobe is lenticular, and profile subconic. In *M. terrærubræ* this tooth is elongate, with well developed heel and anterior lobe. The alveolus of the canine is relatively larger than that of the *M. terrærubræ*. The coronoid process does not rise so close to the last molar tooth, nor so steeply, as in the latter species. The posterior recurvature of the internal extremity of the anterior limb of the posterior V of the true molars is but little marked.

* American Naturalist, 1882, p 830, Sept, 28th.

<i>Measurements.</i>		<i>M.</i>
Length of true molars on base.....		.018
Diameters M. ii {	anteroposterior.....	.006
	transverse.....	.0044
Diameters M. iii {	anteroposterior.....	.0065
	transverse.....	.0038
Diameters P-m. iii {	vertical.....	.0045
	anteroposterior.....	.004
Width of inferior face of symphysis.....		.008
Depth ramus at P-m. iii.....		.009
" " " M. iii.....		.0103

This species was obtained by Mr. D. Baldwin from beds of probably lowest Wasatch age, in New Mexico.

On the Systematic Relations of the Carnivora Fissipedia. By E. D. Cope.

(Read before the American Philosophical Society, October 20, 1882.)

This order embraces the clawed mammalia with transverse glenoid cavity of the squamosal bone, confluent scaphoid and lunar bones of the carpus, and well developed cerebral hemispheres. It is well distinguished from all others at present known, but such definition is likely to be invalidated by future discovery. Some of the Insectivora possess a united scapholunar bone, but the reduction of the cerebral hemispheres of such forms distinguishes them. The presence of the crucial fissure of the hemispheres is present under various modifications in all *Carnivora*, while the parietooccipital and calcarine fissures are absent.

The many types of existing carnivora fall into natural groups, which are of the grade termed family in zoölogy. But the distinction of these from each other is not easily accompanished, nor is it easy to express their relations in a satisfactory manner. The primary suborders of pinnipedia and fissipedia are easily defined. Various characters have been considered in ascertaining the taxonomy of the more numerous fissiped division. The characters of the teeth, especially the sectorials, are important, as is also the number of the digits. Turner* has added important characters derived from the foramina at the base of the skull, and the otic bulla, which Flower† has extended. Garrod‡ has pointed out the significance of the number of convolutions of the middle and posterior part of the hemispheres. I have added some characters derived from the foramina of the posterior and lateral walls of the skull.§ Mr. Turner also defines the families by the form and relations of the paroccipital process.

* Proceedings Zoological Soc., London, 1848, p. 63.

† Loc. cit., 1869, p. 5.

‡ Loc. cit., 1878, p. 377.

§ Proceedings Amer. Philosophical Society, 1880, p.



Cope, E. D. 1882. "Synopsis of the Vertebrata of the Puerco Eocene epoch." *Proceedings of the American Philosophical Society held at Philadelphia for promoting useful knowledge* 20(112), 461–471.

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