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Art. XVI.—On the Extinct Species of Rhinoceridæ of North America and their Allies.*

By E. D. Cope.

Twelve species of mammals which may be called rhinoceroses, have been defined from materials obtained from the Tertiary formations of North America; and five additional species have been distinguished, which may be regarded as more or less nearly allied to that family. A few additional names have been proposed for supposed species whose characters are not yet established. In the corresponding formations of Europe and Asia, the fossil remains indicate a still larger number of species. The forms here included first appear in both continents in the Lowest Miocene or Oligocene epochs; that is, in North America in the White River formation.

The proper definition of the family *Rhinoceridæ* is not yet perhaps attainable, owing to our ignorance of the structure of some of the earlier forms. The description given by Huxley† is evidently not designed to be a family diagnosis, as various generic and other characters are introduced. Perhaps the dental formula at the head of his article may be regarded as such, from the context. It is I. $\frac{1-1}{1-1}$ or $\frac{0-0}{0-0}$; C. $\frac{0-0}{0-0}$; Pm. $\frac{4-4}{4-4}$; M. $\frac{3-3}{3-3}$. Of this it may be remarked that the superior incisors are sometimes $2-2$; the canines are frequently $\frac{0-0}{1-1}$; and the premolars are often $\frac{3-3}{3-3}$. A little later,‡ Professor Gill offered a special diagnosis, as follows:

"*aa.* Neck abbreviated. Incisor teeth (attypically reduced in number or entirely suppressed. (*Rhinocerotoidea Rhinocerotiformia.*)

"Skull with the basioccipital comparatively well developed behind and narrowed forwards (with tympanic and periotic bones anchylosed and wedged in between the squamosal, exoccipital etc., Huxley), with the nasal bones produced forwards and more or less arched and meeting an upward development of the supramaxillary bones. Upper molars with a deep valley extending obliquely inwards from the median portion of the inner wall, and (P. M. 4, M. $1-2$) a shallow one extending from

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* Read before the National Academy of Sciences, April, 1879.

† The Anatomy of Vertebrated Animals, p. 307, 1872.

‡ Arrangement of the Families of Mammals: Smithsonian Misc. Pub. Nov. 1872, p. 85.

the posterior wall. Lower molars (P. M. 2, M. 3) with two curved transverse crests."

Of these characters, it may be remarked, that those derived from the molar teeth must be included in a diagnosis of this family, because they belong to it, although they do not distinguish it from the tapiroid groups; the one character of the superior molars (see my diagnosis below) which defines the family, being omitted by Professor Gill. Of those derived from the cranium, the form of the nasal bones is specific or generic, and that of the basioccipital, one of proportion only. The statement as to the periotic bones does not express the peculiar character of the family, but describes the condition usual in the order. The union of the maxillary and nasal bones is also found in the tapirs. The reduction of the superior incisor teeth is a significant character, and the length of the neck may be so also. Under these circumstances, I will endeavor to offer a definition free from the above objections in the present state of our knowledge. At the same time I propose to make the genus *Hyracodon* the type of a distinct family, as I have found its characters to be much more distinct from those of the *Rhinoceridæ* than has been supposed. I introduce these families by distinguishing them in an analytical table from those of several other families of Perissodactyles, mostly extinct.

I. The external crescentoid crests of the superior molars subequal; inferior molars with crescents.
   1. Inner part of crown of superior molars supporting tubercles.... *Chalicotheriidæ.*
   2. Inner part of crown of superior molars supporting cross-crests... *Palæotheriidæ.*

II. Exterior crescentoid crests of superior molars subequal; inferior molars with cross-crests.
   3. Superior molars and premolars alike and with cross-crests ..... *Tapiridæ.*

III. Anterior exterior crescent of superior molars shortened; inferior molars with cross-crests; premolars different from molars.
   4. Superior molars with cross-crests; a diastema ..... *Lophiodontidæ.*
   5. Molars as above; no diastema ..... *Tapirulidæ.*

IV. Anterior exterior crescent of superior molars much reduced; inferior molars with cross-crests; superior molars and premolars alike, with cross-crests.
   6. Mastoid bone forming part of the external wall of the skull; no postcotyloid tuberosity of the mandible; neck elongate ..... *Hyracodontidæ.*
   7. Mastoid bone excluded from the walls of the skull by the contact of the occipital and squamosal; a postcotyloid tuberosity of the mandible; neck short ..... *Rhinoceridæ.*

The genera of *Chalicotheriidæ* are as follows: Eocene: *Limnohyus* Leidy; *Palæosyops* Leidy; *Leurocephalus* S. L. & S. Oligocene: *Menodus* Pom.; *Symborodon* Cope; *Dæodon* Cope. Miocene: *Chalicotherium* Kaup; *Nestoritherium* Kaup.

The genera of *Palæotheriidæ* are, *Palæotherium* Cuv., *Propalæotherium* Gerv., *Paloplotherium* Ow., and perhaps some others.

The *Tapiridæ* include *Tapirus* L., Miocene to recent; Miocene, *Listriodon* Meyer, *Tapiravus* Marsh, *Anchisodon* Cope.

The *Lophiodontidæ* embrace: Eocene forms, *Lophiodon* Cuv., *Pachynolophus* Pom., *Hyrachyus* Leidy, *Colonoceras* Marsh.

The only genus of *Tapirulidæ* is the Eocene *Tapirulus* Gervais.
The genera of the *Rhinoceridæ* differ as follows:

I. Four anterior digits.
Incisors $\frac{2}{1}$; canine $\frac{0}{1}$; no horn; posttympanic bone distinct ..... *Aceratherium.*

II. Three anterior digits.
Incisors $\frac{?\,2-1}{1}$; canines $\frac{0}{1}$; no horn; posttympanic bone distinct ..... *Aphelops.*
Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; a dermal horn; posttympanic distinct ..... *Ceratorhinus.*
Incisors $\frac{3}{2}$; canines $\frac{0}{1}$; a dermal horn; posttympanic ? ..... *Zalabis.*
Incisors $\frac{1}{1}$; canine $\frac{0}{1}$; a dermal horn; posttympanic process coössified with postglenoid process; no nareal septum ..... *Rhinocerus.*
Incisors $\frac{0}{0}$; canines $\frac{0}{0}$; a dermal horn; posttympanic process not united with postglenoid; no nareal osseous septum ..... *Atelodus.*
Incisors $\frac{0}{0}$; canines $\frac{0}{0}$; a dermal horn; posttympanic coösified with postglenoid; an osseous septum narium ..... *Cœlodonta.*

The species of these genera are the following; the names of the existing species are in Roman letters, the extinct ones in italics:

ACERATHERIUM Kaup.
A. incisivum Cuv. Middle Miocene. Europe.
A. gannatense Duv. Middle Miocene. Europe.
A. lemanense. Middle Miocene. Europe.
A. mite Cope. Lower Miocene. North America.
A. occidentale Leidy. Lower Miocene. North America.
A. pacificum Leidy. Middle Miocene. North America.
A. truquianum Cope. Middle Miocene. North America.

APHELOPS Cope.
A. meridianus Leidy. Upper Miocene. North America.
A. megalodus Cope. Upper Miocene. North America.
A. fossiger Cope. Upper Miocene. North America.
A. malacorhinus Cope. Upper Miocene. North America.

CERATORHINUS Gray.
C. sumatranus Cuv. Recent. Sumatra.
C. lasiotis Sclater. Recent. Malacca.
C. schleiermacheri Kaup. Middle Miocene. Europe.
C. aurelianensis Gaudry. Upper Miocene. Europe.

ZALABIS Cope, gen. nov.
Z. sivalensis C. F. Upper Miocene. India.

RHINOCERUS Linn.
R. unicornis L. Recent. India.
R. sondaicus Cuv. Recent. Java.
R. palæindicus C. F. Upper Miocene. India.
R. platyrhinus C. F. Upper Miocene. India.

ATELODUS Pomel.
A. bicornis Linn. Recent. Africa.
A. simus Burch. Recent. Africa.
A. pachygnathus Wagn. Upper Miocene. Europe.
A. leptorhinus Cuv. Pliocene. Europe.

CŒLODONTA Bronn.

C. etruscus Falconer. Pliocene. Europe.
C. hemitœchus Falc. Postpliocene. Europe.
C. antiquitatis Blum. Postpliocene. Siberia; Europe.

The above list embraces twenty-seven species, of which six are living. There are probably several other distinct fossil species; but their characters have not yet been sufficiently made known to enable me to refer them to their proper places. It will be observed, from the preceding catalogue, that eight species have been found in North American formations, ten in European, and three in those of Hindostan. It appears also that no extinct species of the true genus of *Rhinocerus* has yet been found in North America or Europe, and that no extinct rhinoceros of North America which is known, possessed a median dermal horn.

It can readily be seen that the genera above defined form a graduated series, the steps of which are measured principally by successive modifications of four different parts of the skeleton. These are, first, the reduction of the number of the toes of the anterior foot; second, the reduction in the number and development of the canine and incisor teeth; third, the degree of closure of the meatus auditorius externus below; and, fourth, in the development of the dermal horns of the nose and its supports. While these characters have that tangible and measurable quantity which renders them available for generic diagnosis, there are others which possess a similar significance, and which I now notice, so far as they are observable in the extinct species of North America.

I premise by observing that the *Aceratheria* of this continent have only been found in the eastern and western divisions of the White River formation, while the species of *Aphelops* are confined, so far as is known, to the Upper Miocene or Loup River formation.

The posttympanic process is, it is well known, well separated from the postglenoid process in the tapir, so as to leave the auditory meatus widely open below. The arrangement is similar in *Hyracodon*. In *Rhinocerus*, as shown by Flower, the meatus is closed below by the coösification of the two processes. In the oldest genus of the family *Aceratherium*, the relations of the parts are as in *Hyracodon*. In *Aphelops* the two processes approach each other, but do not come in close contact as in the genus *Ceratorhinus*.

The postglenoid process is low and transverse in the tapirs; in *Rhinocerus* it is long and has a triangular section. In some species of American *Aceratheria* its form is much like that of the tapirs (*A. mite*, *A. occidentale*); while in others (*A. pacificum*) and in the species of *Aphelops* the form of this process is as in *Rhinocerus*.

In the tapirs, the foramina sphenoörbitale and rotundum are distinct. They are also distinct in *Aceratherium mite*. In *A. pacificum* they are confluent, but the walls of their orifice present two opposite projections, which are the rudiments of a dividing septum. In *Aphelops* these

foramina are one, as in *Rhinocerus*. At the same time, the external wall of the alisphenoid canal is shorter and thinner in the *Aceratheria* than in the *Aphelopes*.

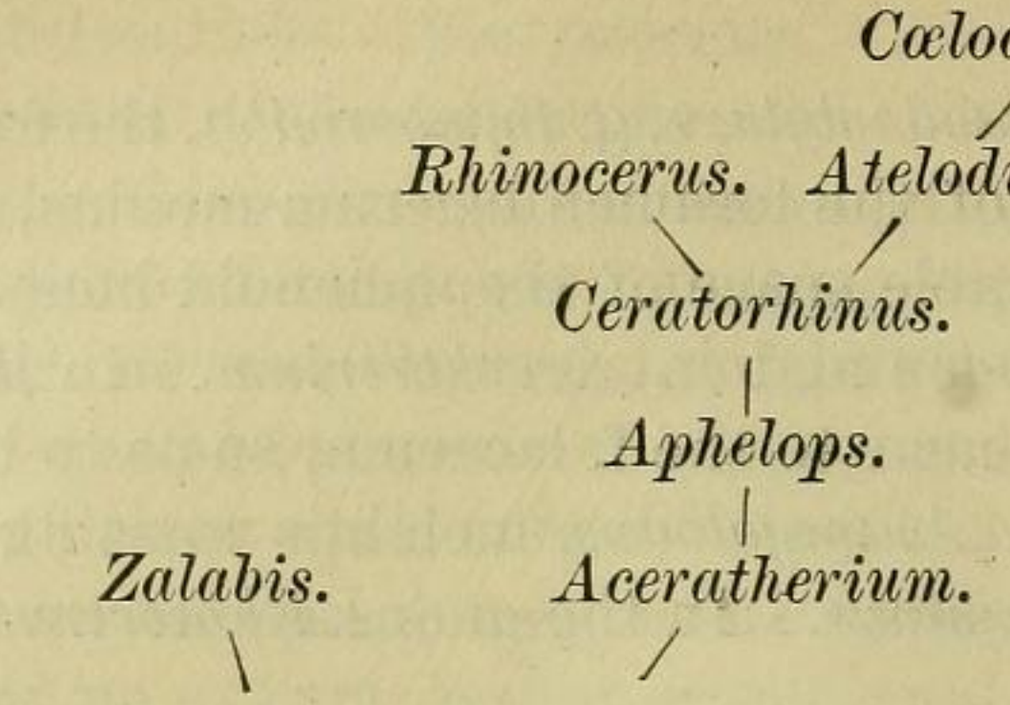
In the older types of *Perissodactyla*, e. g. *Symborodon*, the foramen ovale is situated well in advance of the foramen lacerum medius, and is separated from it by a considerable space of the sphenoid bone. The same structure is seen in *Hyracodon* and in *Aceratherium*. In *Aphelops*, the foramen ovale approaches near to the f. lacerum, so as to be separated by a narrow bridge only in *A. megalodus*, which is wanting on one side in a specimen of *A. malacorhinus*. In the genus *Rhinocerus*, these foramina are not divided.

In the structure of the teeth, the same serial order is to be observed. Commencing with the incisors $\frac{3}{3}$ in the tapiroid types and *Hyracodon*, and canine $\frac{1}{1}$, we find $\frac{3}{2}$ $\frac{0}{1}$ in *Zalabis;* $\frac{2}{1}$ $\frac{0}{1}$ in *Aceratherium;* $\frac{2-1}{1}$ $\frac{0}{1}$ in *Aphelops;* $\frac{1}{1}$ $\frac{0}{1}$ in *Ceratorhinus* and *Rhinocerus*, to $\frac{0}{0-1}$ $\frac{0}{0}$ in *Atelodus* and *Cœlodonta*. As to the molars, in those of the upper jaw the series of modifications consists of successive complication of the transverse crests. In *Hyracodon*, as in the tapiroid genera, the external wall of the posterior molar is continued beyond the posterior cross-crest; in the *Rhinoceridæ*, generally the external wall is not continued beyond this crest, but is in line with the posterior cross-crest. In a specimen of *Aceratherium occidentale*, the posterior superior molar of one side is like that of *Hyracodon*, while that of the other side is like that of *Rhinocerus*. The cross-crests in *Aceratherium* are quite simple, having slight bulges into the median valley. In the species of *Aphelops* these bulges are more prominent, especially that of the posterior crest, which is more externally situated than that of the anterior cross-crest, so that the fundus of the valley is turned abruptly backwards. In several of the existing species, this bulge becomes an antero-posterior crest, and the fundus is further divided by other crests from the outer wall and elsewhere. The cingula become so elevated as to cause an isolation of the valleys as fossæ at a comparatively early stage of wear. This state of things commences in the extinct species of Kansas, the *Aphelops fossiger*.

In the bones of the skeleton, modifications accompanying those of the cranium and dentition may be observed. The femur of the species of the earlier formations may be readily distinguished from that of those of the later Tertiaries by the forms of both the extremities. In the *Aceratheria* this bone resembles that of the tapirs in the form of the great trochanter. This process is produced at its external border, has a recurved apex, and encloses a deep trochanteric fossa. In *Aphelops* it is precisely as in *Rhinocerus*, obliquely truncate externally, without prominent apex or well marked fossa. In the *Aceratheria* the inner crest of the rotular groove is but moderately prominent; in *Aphelops* and *Rhinocerus* it is greatly developed.

The succession of development of the line of the *Rhinoceridæ* is now

not difficult to trace, and I give the following diagram in explanation of it.



It is evident that the descent diverged at a comparatively late period of geological time into two lines, which are represented at the present day by the African and Indian species respectively. The earliest species of the toothless or African series is the *Atelodus pachygnathus* of Wagner, whose characters have been so well worked out by Gaudry in his great work on the Fossil Fauna of Attica. That species sometimes presents a single small incisor or canine tooth in the mandible. From what has preceded it is also apparent that the generally most specialized type of rhinoceros, the genus *Cœlodonta*, has become entirely extinct. Its species yet known, were confined to Europe and Northern Asia, and the most formidable of them extended its range with the hairy mammoth within the Arctic circle. The *Cœlodonta antiquitatis* was evidently the most effectively armed of the family, as it had two horns, which, judging from the character of the surface of the skull to which they were attached, must have been of unusual size. To provide further against the shocks incident to their use in combat, the nareal septum was ossified, thus becoming a solid support to the nasal bones, etc., on which they stood.

It remains to look backwards, and to discover, if possible, the probable origin of the family in that of its earliest known genus, *Aceratherium*. A late survivor of this ancestral type is seen in the genus *Zalabis* Cope, of which one species, the *Z. sivalensis*, has been discovered by Cautley and Falconer in the late Tertiary of Hindostan. In this form, according to Falconer, there are $\frac{3}{2}$ incisors and $\frac{0}{1}$ canines. The early type, which corresponds most nearly with this genus, and which preceded the *Aceratheria* in time, is the genus *Amynodon* Marsh, which has left a species in the Uinta or Upper Eocene of Utah. Here the incisors are $\frac{2}{2}$ and the canines $\frac{1}{1}$. This formula is intermediate between that of *Aceratherium* and that of the Eocene tapirs, where the normal numbers $\frac{3}{3}$ $\frac{1}{1}$ prevail. According to Marsh, *Amynodon* further differs in the primitive condition of the premolars above, which, as in the *Lophiodontidæ*, differ from the molars in their greater simplicity. Thus it is probable that tapiroid animals, probably *Lophiodontidæ*, gave origin to the *Rhinoceridæ*, as Marsh has suggested. And it is further altogether probable that the general type of dentition presented by the *Rhinoceridæ*, *Lophiodontidæ*,

etc., which I have named the palæotheriodont, took its origin from the type which is intermediate between it and the bunodont, viz, the symborodont, as I have pointed out in an essay on this subject.*

The first appearance of dermal horns was apparently in a pair placed transversely on the nasal bones, in species of Eocene *Lophiodontidæ* of the genus *Colonoceras*. The same character has been observed by Marsh in species of the Lower Miocene, which probably belong to the true *Rhinoceridæ*, and which he has called *Diceratherium*. This genus appears to have terminated the line exhibiting this structure, and the family in North America remained without horn. As we have seen, the types possessing the median horn arose in Europe, in the *Ceratorhinus schleiermacheri* of the Middle Miocene, and still survives.

It may be observed in conclusion that a successive increase of size in the species of this line has taken place in North America with the advance of geologic time. Thus, their probable ancestors of the genus *Hyrachyus* were the least of all. The *Aceratheria* of the White River formation were larger; the oldest, *A mite*, being the smallest; and the later *A truquianum* of Oregon, being the largest. The species of the Loup River or Upper Miocene formation were all larger, and were nearly equal to the large existing species.

The characters of the American genera and their allies, *Hyracodon* and *Anchisodon*, are pointed out in the following pages.

ANCHISODON Cope.

American Naturalist, 1879, 270, April; published March 26, 1879.

This genus is represented by maxillary teeth only, so that the characters of the incisor teeth and inferior molars are unknown. There are four premolars and three true molars. The true molars are constructed much as in *Lophiodon*. They have two external confluent crescents, each of which gives origin at its anterior part to a transverse crest, which is directed more or less obliquely backwards. The anterior part of the anterior external crescent is well developed, and not shortened as in *Aceratherium* and *Rhinocerus*, and terminates in a low cusp. The external wall of the last true molar is continued posterior to the posterior transverse crest as in tapiroid types. The third and fourth premolars resemble the true molars. The second premolar differs from the others in a relatively greater elongation of the external portion, which presents three cusps instead of two. Of these one is opposite to the origin of each cross-crest, and the third is between them. The anterior part of the anterior external crescent is produced, as is also the posterior part of the posterior.

In the milk dentition, the teeth which occupy the position of the third and fourth permanent premolars are first protruded, and afterwards the second deciduous premolar, and later the first true molar.

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*The Homologies and Origin of the Molar Teeth of Mammalia, etc. Journal Academy Nat. Sciences, Philada., 1874, pp. 13–14.

Two species of this genus are known to me, one of which has been found in the White River beds of Colorado, and the other in the corresponding horizon in Oregon, viz: the *A. quadriplicatus* and the *A. tubifer*.

Without fuller material it is not easy to determine the near affinities of *Anchisodon*. While the identity of the forms of some of the premolar and molar teeth is much as in the *Rhinocerida*, and distinguishes the genus from *Lophiodon*, *Hyrachyus*, etc., the details of the molars are more like those of the latter genera. The elongation of the second premolars have, on the other hand, a point of similarity to the *Anchitheroid* forms.

HYRACODON Leidy.

Proceedings of the Academy of Natural Sciences, Philadelphia, 1856, p. 92; 1857, p. 89; Extinct Fauna Dakota and Nebraska, p. 232.

Professor Leidy has published the dental and several cranial characters of this genus, so that there remain but few of these to be observed. Professor Marsh has stated the number of the toes,* and I will add some points not noticed by either of these paleontologists.

The dental formula is I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{3}$; M. $\frac{3}{3}$. The incisors and canines form uninterrupted series in both jaws, which are separated by diastemata from the molar series. In their unworn condition, the crowns of the incisors and canines are subconic. The molars of both jaws do not differ in character from those of *Aceratherium*, but the last superior molar differs in not having the posterior cross-crest confounded with the external wall.

According to Leidy, the premaxillary bone reaches the base of the nasal. The temporal fossæ are large and approach each other above. A character heretofore unnoticed is the appearance of the mastoid bone between the posttympanic and the paroccipital processes, as in horses, thus differing from rhinoceroses. As in *Aceratherium*, the posttympanic does not close the meatus auditorius inferiorly. Postglenoid well developed. This genus also differs from the rhinoceroses in the absence of the tuberosity behind the condyle of the lower jaw.

The vertebral column is characterized by the length of the cervical portion as compared with the dorsal, especially of the axis. The vertebrarterial canal is long and external; the centra are keeled below, and the transverse processes of the atlas are not elongate. The opisthocœlous character is well marked in both cervical and dorsal centra. The zygapophysial facets of the dorsals are not recurved in any way, and there are some metapophyses on the posterior dorsals. There are no enclosed spinal foramina on the dorsals. Lumbars unknown.

A single species of this genus, the *H. nebrascensis*, was found by Hayden in Nebraska, and I obtained in Colorado in 1873 a second one, the *H. arcidens*.

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*Amer. Journ. Sci. Arts, 1877, p. 361.

ACERATHERIUM Kaup.

Isis, von Oken, 1832; Jahrbuch für Mineralogie, 1832, 419; Ossemens Fossiles, 49–61.

Dentition: I. $\frac{2}{1}$; C. $\frac{0}{1}$; Pm. $\frac{4}{3-4}$; M. $\frac{3}{3}$; digits 4—3; nasal bones without horn basis.

This genus is characteristic of the Miocene or Middle Tertiary formations of Europe, and is the primitive form of the true rhinoceroses. Its four anterior digits relate it to the lower or more generalized perissodactylous types of the same and of older geological horizons, which are equally allied to the tapirs. The dentition differs from that of the genus *Rhinocerus* in the presence of two superior incisors, but agrees with it in the existence of one incisor and one canine on each side below, and in the forms of the premolar teeth. The species display great simplicity in the character of the crests of the molars. They also possess the tapiroid feature of the non-closure of the auditory meatus below by the posttympanic process; and the postglenoid process is generally more like that of the tapirs than are those of the later genera *Aphelops* and *Rhinocerus*. The form of the femur is also quite characteristic, presenting tapiroid characters again in the shape of the great trochanter. This process is not flat and obliquely truncated as in the genera above named, but is horizontal proximally, and with a produced recurved apex and posterior crest, which bound a large fossa.

In this paper, four species are referred to this genus, but provisionally only, on account of the absence of certain diagnostic parts of the skeleton. These species are, in the order of size, beginning with the smallest, as follows: *A. mite* Cope; *A. occidentale* Leidy; *A. pacificum* Leidy; *A. truquianum* Cope. I only possess the feet in *A. pacificum*, and these are not entirely complete; the nasal bones are wanting from all my specimens. The inferior incisors or canines are present in all; but I have only the superior incisor of *A. pacificum*. Leidy describes that of *A. occidentale*, and I have the premaxillary bones with the incisive alveoli of the same. I possess the posterior cranial regions of all the species except the *A. truquianum*, and these present the characters above described.

The species above mentioned are generally of smaller size than those of the Loup Fork formation, which have been referred to the genus *Aphelops*. The largest *Aceratherium*, *A. truquianum*, is not much less than the smallest of the *Aphelopes*, *A. megalodus*.

Should any of the four species here included be found to possess but three toes in the anterior foot, such must be referred to *Aphelops*.

APHELOPS Cope.

Paleontological Bulletin, No. 14, p. 1, July 25, 1873.—Proceedings Amer. Philosophical Society, 1873, (1874), p. 520.—Hayden's Ann. Report U. S. Geol. Survey Terrs., 1873, (1874), p. 519.—Report U. S. Geol. Geogr. Surv. W. of 100th Mer., G. M. Wheeler, vol. iv, pt. ii, p. 315.

Dental formula; I. $\frac{?\,1}{1}$; C. $\frac{0}{1}$; Pm. $\frac{4-3}{3}$; M. $\frac{3}{3}$. Digits 3—3. Nasal bones with persistent suture, weak, not supporting a dermal horn.

This genus occupies a position intermediate between *Aceratherium* Kaup and *Rhinocerus* Linn. It agrees with the former in the presence of incisor and canine teeth, and in the absence of indication of a nasal horn, but differs from it in lacking the fifth digit of the anterior foot. In the last respect it is identical with the genus *Rhinocerus*, differing from it in characters already mentioned, in which it agrees with *Aceratherium*. From *Atelodus* Pom. it differs still more widely, as that genus wants incisor and canine teeth.

The evidence on which this genus rests is furnished by two species, the *Aphelops megalodus*, and a second form, whose bones I have provisionally associated with the crania of *A. fossiger*. In both of these animals, the number of anterior digits is known to be only three, and in the former the inferior canines and alveoli for incisors can be seen in the specimens. In two other species provisionally referred to the same genus, the *A. crassus* and *A. malacorhinus*, the digits and incisor teeth are unkown, but the last named species was certainly hornless, and it is supposed that the first named was so also. Of the many mandibular symphyses from the Loup Fork formation which I have seen, none lack the canines and incisor teeth, so that it is probable that this character belonged to the two species above mentioned. A fifth species, the *A. meridianus* Leidy, I have provisionally referred here on account of the similar character of the mandibular dentition; but its nasal bones and feet are unknown. Still another species, the *A. jemezanus* Cope, has been referred here, but on no other ground than that it is found in the same formation as the others.

Specific characters.—The species above named all present well-marked cranial or dental characters, or both. But it is important to take into consideration the general structure of the skeleton. I am in position to do this with three of the species named, the *A. megalodus*, the *A. fossiger* (of this paper), and the *A. malacorhinus*, and find distinctive characters present in nearly all their bones which I have observed. The *A. malacorhinus* is a comparatively long-limbed animal, and its apparent elevation was increased by the shortness of the body, and especially of the neck. There was probably a great development of the upper lip, or snout, and the face was concave in profile. The *A. megalodus* was somewhat intermediate in proportions between this species and the *A. crassus*. Its limbs were shorter than in the *A. malacorhinus*, and the neck was longer. The feet were more slender. The *A. fossiger* had still shorter legs, and the length of the neck was about as in *A. malacorhinus*.

In its form it must have been much like a *Hippopotamus*. Its limbs, and especially the feet, were very robust.

The five species may be distinguished by the characters of their superior molar teeth as follows:

I. Fundus of the transverse valley divided by processes.
Posterior marginal fossa open; transverse crests, the posterior with a long anterior process, the anterior with a long posterior process ....*A. crassus.*

II. Fundus of transverse valley without processes.

a. Posterior marginal fossa open, except in advanced wear.
Posterior cross-crest with a strong anterior process; premolars with a cingulum extending round the posterior cross-crest.....*A. malacorhinus.*
Posterior cross-crest with strong anterior process; no cingulum on posterior cross-crest of premolars; internal cingulum of true molars; smaller. *A. meridianus.*
Posterior cross-crest with little or no anterior process; cingulum wanting from posterior cross-crest of premolars and from inner side of true molars; larger .....*A. megalodus.*

aa. Posterior marginal fossa enclosed by a high posterior cingulum.
Strong anterior process of posterior cross-crest and posterior process of anterior cross-crest; no cingulum on true molars; large .....*A. fossiger.*

Position.—The longest known species, the *A. crassus*, was found by Dr. Hayden on the Niobrara River, Nebraska. Teeth presenting the same characters have been found in Northern Kansas and Eastern Colorado. The other species are more restricted geographically. A considerable exploration in the Loup Fork beds of Northeastern Colorado, conducted by myself in 1873, yielded four individuals of *A. megalodus*, but no fragments referable to the other species. Explorations in Northern Kansas produced three individuals of *A. fossiger* and four of *A. malacorhinus*, but not a fragment of *A. megalodus*.

History.—In my original definition of this genus, I relied on the number of premolars in distinguishing it from *Rhinocerus*, as well as on the absence of the horn. These teeth are generally $\frac{3}{3}$ in *Aphelops*, and are said to be $\frac{4}{4}$ in *Rhinocerus*, in most works on the subject. These numbers are not constant; on one side of both jaws in *Aphelops* from Colorado I have observed a first premolar, and on one side of the upper jaw of *A. malacorhinus* there are four premolars; the other side is injured. In several species of *Rhinocerus*, three premolars only are usually found in the mandible. I may add that Lesson and Peters* have described a *Rhinocerus inermis* Less., which is found living on some of the islands at the mouth of the Ganges. The only known specimens are the skulls with portions of the skin, of a female and young. These are hornless, and in general structure allied to the *R. sondaicus*, yet presenting some important differences.† Should the characters of this form prove to be specific, and the male be found to lack the horn, it must be regarded as a species of *Aphelops*.

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*Monatsberichte Berlin. Akademie, 1877, p. 68, pl. 1–2.

†Peters represents the posttympanic as not coössified below the meatus as in *R. sondaicus*.