

## AMERICAN OLIGOCENE RHINOCEROSSES—A POSTSCRIPT

BY HORACE ELMER WOOD, 2ND

This paper is essentially a series of appendices to my earlier paper (Wood, 1927), consisting of material that can not, logically, be included in other papers now in preparation. It consists of a description of two interesting specimens of American Oligocene rhinoceroses in the museums of Munich and Berlin, which I came across during the summer of 1927, while making a comparative study of European fossil rhinoceroses, and a number of minor corrections of, and additions to, my earlier paper.

I wish to acknowledge my obligations to Drs. W. O. Dietrich, W. Janensch and J. F. Pompeckj of the Berlin Museum, and to Drs. F. Broili and M. Schlosser of the Munich Museum, for making these specimens available and for numerous other courtesies, and to Dr. G. G. Simpson, for a microscopic study of a sample of matrix. I am greatly indebted for the drawings to Dr. Florence Dowden Wood.

*Eotrionias rhinocerinus* Wood, 1927

In my earlier paper (pp. 32-33, pl. 1) I did not consider the exact horizon of this species in the Uinta as being established. However, in answer to a question on this subject, O. A. Peterson states, in a letter dated April 26, 1928: "the mouths of Lake Fork and Duchesne streams are located in what has been regarded as horizon C of the Uinta Eocene sediments." The collector stated "near the mouth Lake Fork." It therefore seems justifiable to refer the type of *Eotrionias rhinocerinus* to Uinta C with fair confidence. Its evolutionary stage would accord satisfactorily with this horizon at the summit of the Eocene.

*Subhyracodon occidentale* (Leidy). (Figs. 1-4)

This specimen, which I studied in the Munich Museum, no. 1897 X 18, a skull with the lower jaws, seems to represent a progressive stage of *Subhyracodon occidentale* (strictu sensu) foreshadowing *S. metalophum*. It is labelled *Aceratherium mite* Cope, from the White River Beds, Indian Creek, Wyoming, Geschenk v. Herrn Commerzienrat Th. Stützel. The original label gives the horizon as the Titanotherium Beds. Both Titanotherium and Oreodon beds are exposed to the south side of Indian Creek, Wyoming.

There is no trace of horn cores or rugosities. The premaxillaries are

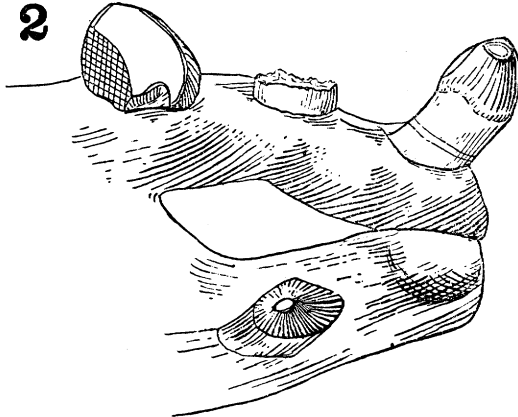
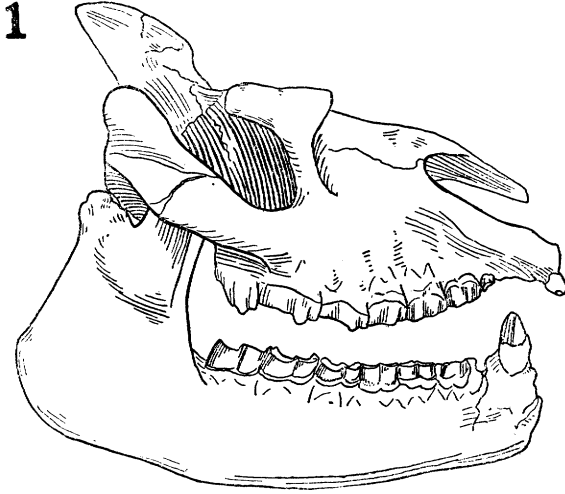


FIG. 1. *Subhyracodon occidentale*, Munich Museum, right side of skull about  $\times\frac{1}{4}$ . This figure is based on a lined-in and faded-out photograph furnished through the kindness of Dr. Schlosser. FIG. 2. *Subhyracodon occidentale*, Munich Museum, upper incisors and first premolar, crown view,  $\times 1$ .

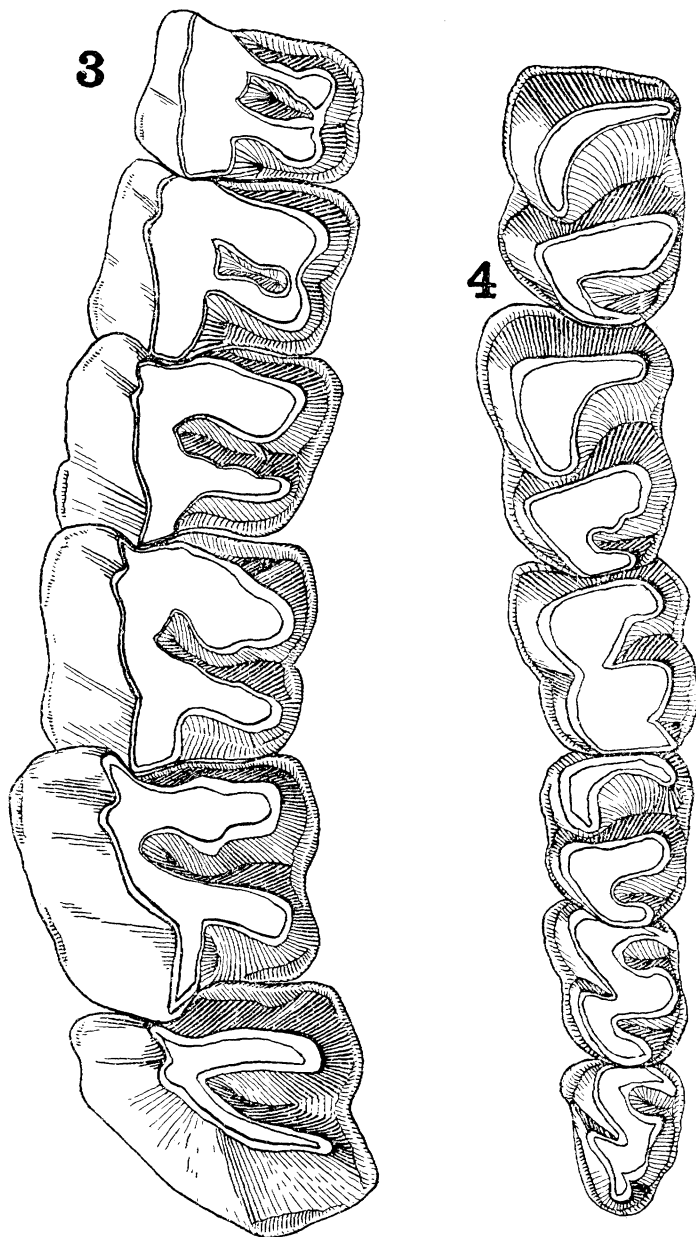


FIG. 3. *Subhyracodon occidentale*, Munich Museum, right  $P^2-M^3$ , crown view,  $\times 1$ . FIG. 4. *Subhyracodon occidentale*, Munich Museum, right  $P_2-M_2$ , crown view,  $\times 1$ .

in contact at their tips, but are not suturally connected. The skull, although complete, has been severely crushed from front to back, and the tooth dimensions are thereby slightly distorted.  $I_2^3$ ,  $C_0^0$ ,  $P_4^3$ ,  $M_3^3$ . Right  $I^1$  is abnormally small. It may not belong where it has been plastered on, but may represent  $RI^2$  of this or another specimen. However, as the rear of the crown is worn, it is more likely that it is a  $dI^1$ , either from another specimen, or else that it had never been replaced. The internal cingula of the upper cheek teeth and the external and internal cingula of the lower cheek teeth are strong as in *Subhyracodon*, instead of weak as in *Caenopus mitis*.  $P^{2-4}$  have the cross lophs connected by mures. In the well advanced stage of wear of this individual, a connection, by way of the mures,<sup>1</sup> between the exposed dentine of the protoloph and the metaloph of  $P^{2-3}$ , has just barely been established. In  $P^4$  the mure is still unworn, and the dentine areas of the lophs are separate.  $P_4$  has the posterior crescent fully developed and elevated, so that, presumably, the entoconid was the highest point of the unworn talonid. In  $P_{2-3}$ , the entoconid is still materially lower than the hypoconid.  $I_2$  is very erect, largely, however, as a result of crushing. The upper teeth are sufficiently crushed to distort their measurements somewhat, and all anteroposterior measurements tend to be too short. The lower cheek teeth were not appreciably distorted. The measurements given in the table compare fairly closely with *Subhyracodon occidentale*; allowing for the crushing, they compare very closely.

In all respects except the character of  $P^4$ , this specimen seems clearly referable to *Subhyracodon occidentale*.  $P^4$  is of the type characteristic of *S. metalophum*. This specimen, then, gives strong confirmation to the traditional view that *S. occidentale* (rather than *S. trigonodum*) gave rise, by way of *S. metalophum*, to *S. tridactylum*. In my previous paper (Wood, 1927), I did not consider either alternative as proved. This specimen is also of considerable interest as suggesting a downward extension of the range of *S. occidentale* (and of a progressive stock, at that) into the Titanotherium Beds, if the original label can be relied on.

<sup>1</sup> The term "mure" was proposed by Troxell in "A Study of Diceratherium and the Diceratheres," Am. Jour. Sci., II, p. 202, text and fig. 6, Oct., 1921. "The premolars are distinctly bridged from loph to loph and united by a wall, which may be technically known as the mure, projected across the median valley effectively damming it up in such a way as to form the deep central pit completely surrounded by an enamel border."

*Caenopus dakotensis* Peterson. (Figs. 5-7)

This skull and lower jaws, in the Berlin Museum, is to be regarded as the plesiotype (or homeotype, according to taste) of *Caenopus dakotensis* Peterson. The skull was labelled "Aceratherium Copei Osb.," from the "White River Bad Lands." It was bought, probably from Dr. F. Krantz of Bonn or, possibly, from Mr. Stillwell of Deadwood, South Dakota. The level and exact locality are unfortunately not recorded. The matrix is definitely not of the "red layer" type; there is nothing inconsistent with its being Protoceras Beds, with a possibility of the Titanotherium Beds also to be considered. Dr. G. G. Simpson, of the American Museum, after a microscopic examination of a sample of the matrix, regards it as rather more probably Protoceras Beds than Titanotherium Beds, and agrees with me that there is slight probability of its being from the Oreodon Beds.

The front of the skull is lost, so that there is no evidence as to the presence or absence of horn cores. The inner edges of the temporal ridges were already well separated, being 11 mm. apart at their closest. The infraorbital canal opens over the crack between  $P^2$  and  $P^3$ . The posterior nares open opposite the protoloph of  $M^2$ . The external auditory meatus was apparently widely open ventrally.

The teeth present are  $RP^2-M^3$ ,  $LP^3-M^3$ , and both rami of the mandible with all the lower molars and the roots of  $RP_{2-4}$  and  $LP_{3-4}$ . The teeth of the two sides are unusually similar. Slight corrections from the left side are made in the drawing of  $RP^3-M^1$ . The upper teeth resemble *Caenopus mitis* more than any other known upper dentition, but are smaller and much more progressive. The lower molars agree very closely, both in measurements and character, with the type mandible of *Caenopus dakotensis* which was described and figured by Osborn (1898) and named by Peterson (1920), and which is also the only specimen hitherto made known. The weakness of all cingula, upper and lower, is a striking *Caenopus* character. The upper teeth have no external cingula, except a small one on the metacone of  $P^3$ .  $P^2$  is much as in *C. mitis*. It is roughly quadrilateral, but somewhat longer at the external than at the internal border. The protoloph and metaloph are parallel and are separate down to a little above the level of the internal cingulum. Well-developed anterior and posterior cingula are present; the internal cingulum occurs only across the median valley. There is a slight internal swell to the paracone, which can be called a crista. There is a slight posterior hook to the metaloph. The parastyle and

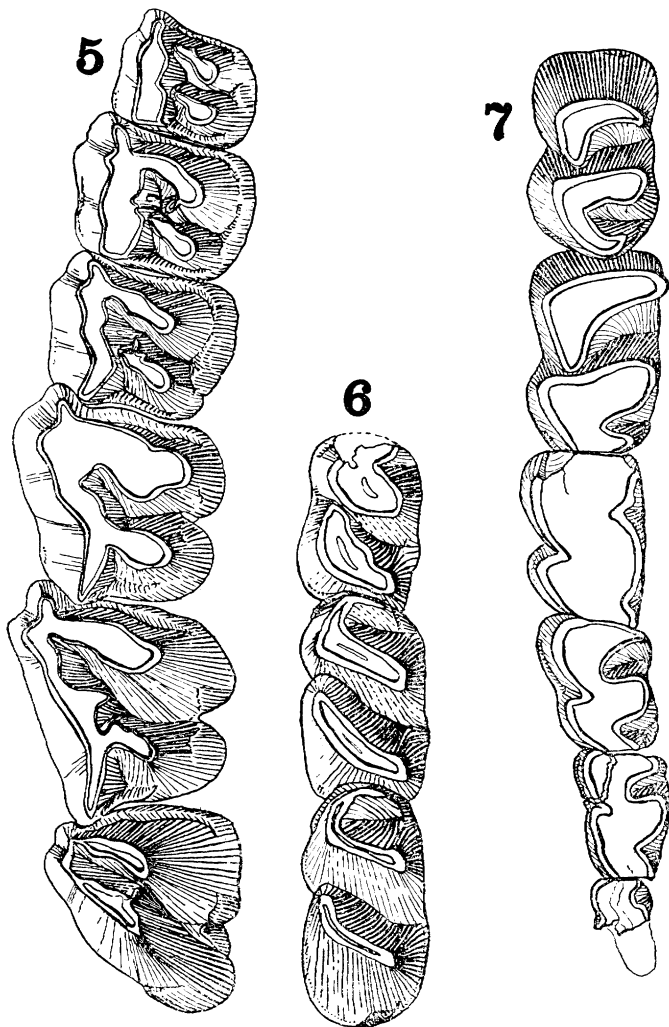


FIG. 5. *Caenopus dakotensis*, homeotype, Berlin Museum, right  $P^2-M^3$ , crown view,  $\times 1$ . FIG. 6. *Caenopus dakotensis*, homeotype, Berlin Museum, left  $M_{1-3}$ , crown view,  $\times 1$ . FIG. 7. *Caenopus dakotensis*, holotype, Amer. Mus. Nat. Hist. No. 1110, right  $P_2-M_3$ , crown view,  $\times 1$ .

paracone are well demarked on the outer face of the ectoloph, the metacone only slightly.  $P^3$ – $P^4$  are nearly quadrilateral. The anterior and posterior cingula are well developed and the internal cingula are present, although interrupted slightly by the protocone, and sharply by the hypocone. The metalophs trend toward the rear, paralleling the protolophs, and remaining fully separate down to below the level of the internal cingula. This more quadrilateral shape, the absence of a mure in  $P^4$ , and the greater demarkation of the lophs of  $P^3$ , all represent distinct advances over the condition in *Caenopus mitis*. In  $P^3$  a mure extends back from the protocone nearly to the metaconule on the right side, and all the way on the left. There is a slight crista; and on the right side, there are two little accessory swellings, one on the crista itself, the other on the front of the metacone.  $P^4$  has a sharp pseudo-crochet, projecting forward from the metaconule, and a second minor fold, just internal to it. There is a slight crista with a small accessory swelling on its rear flank, on the left side; the right is obscured by a bit of firmly-attached matrix. Comparison of the premolars with those of *Caenopus mitis* suggests that the course of premolar metamorphosis was probably similar to that of *Hyracodon* (Sinclair, 1922; Wood, 1926; Abel, 1926; Wood, 1927), but this question must be left open until the earlier stages are made known.  $P^3$ ,  $P^4$ , and  $M^1$  still have the metacone faintly demarked externally. The various secondary folds on  $P^3$ ,  $P^4$ ,  $M^2$ , and  $M^3$  all represent advances over the condition in *Caenopus mitis*. The upper molars have no external cingula, normal anterior cingula, and very short posterior cingula.  $M^1$  has faint traces of an internal cingulum—two little projections on each side of the mouth of the median valley. The protocone is set off moderately from the protoconule, in front, and, slightly, to the rear. The antecrochet is of moderate size. A faint swelling on the metacone foreshadows the crochet. The protocone of  $M^2$  is not well demarked, more so in front than behind. The antecrochet is scarcely distinguishable. A strong crochet projects from the metacone, and there are two smaller folds on the metaconule. Slight internal cingula run up the slopes of the protocone and hypocone, but are not confluent at the bottom of the valley. In  $M^3$ , the ectoloph and metaloph are fully confluent, with no trace of a posterior buttress. On the contrary, there is a faint ridge facing laterally. The protocone is not demarked, nor is there any antecrochet. The sharp crochet almost closes the valley. The anterior cingulum is normal, the posterior cingulum is very short, and the internal cingulum is represented by a cusplule in the middle of the valley, partly continuous with a cingulum on the rear flank of the protocone.

There is no evidence whether  $P_1$  was present or not, as the region is missing. Right  $P_{2-4}$  are represented by double roots. The lower molars are notable for the reduction of their cingula. The anterior cingula are of normal size, there are no external cingula, and no internal cingula except a trace in the valley of  $M_1$ . The posterior cingulum of  $M_1$  is smaller than usual, still more so in  $M_2$ , and a rudiment in  $M_3$ .  $M_3$  has developed a faint supplementary cingulum, externally, posteriorly, and internally, with a slight interruption by the rear of the metaconid. This cingulum, though faint, is continuous, and as it lies

TABLE 1  
*Cranial and upper tooth measurements*

	SUBHYRACODON OCCIDENTALE—MUNICH		CAENOPUS DAKOTENSIS, FLESIOTTPE—BERLIN	
	R.	L.	R.	L.
Across Zygomas.....			151.5	
$P^2$ - $M^3$ .....			130.5	
$P^2$ - $^4$ .....	e 64.0		52.8	
$M^1$ - $^3$ .....	e 93.4	e 90.2	79.8	78.2
Length $P^2$ .....			15.4	
Width $P^2$ .....			19.7	
Length $P^3$ .....			18.6	18.3
Width $P^3$ .....			26.1	26.0
Length $P^4$ .....			19.2	19.2
Width $P^4$ .....			27.4	27.9
Length $M^1$ .....			25.2	24.8
Width $M^1$ .....			30.7	29.6
Length $M^2$ .....			28.1	28.3
Width $M^2$ .....			32.5	32.4
Length $M^3$ .....			26.1	25.9
Width $M^3$ .....			29.7	29.8

below the level of the other cingulum, it is apparently a new structure and shows how new cingula may arise. Otherwise, the lower molars have a thoroughly commonplace rhinocerine pattern.

The lower molars agree almost exactly with the type of *Caenopus dakotensis*, A. M. N. H. no. 1110, and I consider the identification as almost certain. Since Osborn's figure shows the side view only, a figure of the crown surface is included in this paper. The tip of  $I_2$  has been broken off and lost, since it was figured by Osborn. This agreement is confirmed by comparison of the upper teeth with those of *C. mitis*, showing a more advanced stage of evolution of the same plan.



Although the stratigraphic level of this specimen is not recorded, its locality, "White River Bad Lands," makes it almost certain that it is Oligocene; and its stage of evolution is so far advanced that it is difficult to interpret it as being earlier than Upper Oligocene. Including the tentative determination of the matrix, all the lines of evidence converge to the conclusion that the Protoceras Beds are much the most likely horizon, and justify the reference to *C. dakotensis*.

Since the preceding was written, I have received, through the kindness of Drs. Pompeckj and Dietrich, an excellent cast of the skull and rami of the Berlin specimen. Comparison of the rami and their molars with the type, A. M. N. H. no. 1110, shows an exceedingly close resemblance. The type seems as if it would fit well with the cast of the upper teeth, but it is impossible to be sure, as the ascending rami are blocked by the cast before occlusion can be established. Comparison of the casts of the upper teeth with the palate which is the paratype of *Caenopus mitis* Cope show that  $P^4$  and  $M^1$  are very close;  $P^{2-3}$  and  $M^2$  are generally similar but *C. dakotensis* is considerably more progressive. However, it is obviously the same plan in both specimens, and the two species unquestionably belong to the same genus.

Still a third specimen of this species has come to light. During the past summer (1928), I noticed a specimen in the Field Museum labelled "*Caenopus mitis*," no. P 12228, collected by the expedition of 1905 from the Protoceras Beds of the Big Bad Lands of South Dakota. I am permitted to mention this specimen here, through the courtesy of E. S. Riggs. It consists of a part of the skull of a small animal, about the size of *Caenopus dakotensis*, and in close morphological agreement with the Berlin specimen. Unfortunately, the cheek teeth were so badly worn during the animal's life that the pattern is virtually obliterated.  $I^2$   $C^1$  (alveolus)  $P^4$   $M^3$ .  $I^1$  is a small tusk.  $I^2$  is a conical tooth elongated in the antero-posterior axis. A suture follows, posterior to which is an alveolus for the canine.  $P^{1-3}$  have the protoloph and metaloph parallel and separate down to the level of the internal cingulum. The pattern of  $P^4$  is completely obliterated. The region of the internal cingula of  $M^{1-2}$  is broken, giving no information as to its character. The internal cingulum is faint on  $M^3$ , except on the posterior slope of the protocone, where it is well marked.  $M^3$  probably had a crochet. All other features of the crown pattern have been obliterated by wear. It is to be observed then, that there is close agreement with the Berlin specimen in such characters as permit comparison.

Of the various European rhinoceroses, only *Eggysodon* (*Praecera-*

*therium*) *osborni* (= *reichenau*) is at all likely to be even a fairly close relative of *Caenopus dakotensis*. The subject will be discussed in a later paper.

This line of small forms could easily have been derived from *Eotri-gonias*. It seems possible, though not necessarily probable, that *C. pumilus* (Cope), now regarded as a synonym of *C. mitis*, may need to be reestablished for a smaller Lower Oligocene species contemporary

TABLE 2  
*Mandibular and lower tooth measurements*

	SUBHYRACADON OCCIDENTALE— MUNICH		CAENOPUS DAKO- TENSIS, PLESIOTYPE— BERLIN		CAENOPUS DAKOTEN- SIS—TYPE A.M.N.H. # 1110	
	R.	L.	R.	L.	R.	L.
Symphysis.....					48.3	
P <sub>2</sub> -M <sub>3</sub> .....					e 124.5	
P <sub>2</sub> -4.....	65.0		r 47.0		e 49.4	
M <sub>1</sub> -3.....	95.3		77.0	76.6	74.8	76.6
Ramus, below P <sub>2</sub> .....			35.9		38.8	
Ramus, below M <sub>2</sub> .....			41.2	40.7	48.1	46.2
Length P <sub>2</sub> .....					e 12.9	
Width P <sub>2</sub> .....					8.8	
Length P <sub>3</sub> .....					16.8	
Width P <sub>3</sub> .....					e 12.0	
Length P <sub>4</sub> .....					18.4	18.2
Width P <sub>4</sub> .....					14.7	14.5
Length M <sub>1</sub> .....			22.5	22.1	21.7	22.4
Width M <sub>1</sub> .....			15.8	15.8	15.8	
Length M <sub>2</sub> .....			26.2	26.2	26.0	27.2
Width M <sub>2</sub> .....				17.3	16.9	16.4
Length M <sub>3</sub> .....			28.6	28.7	27.0	27.2
Width M <sub>3</sub> .....			16.4	16.5	15.4	15.0

e, estimated; r, along roots.

with *C. mitis* and ancestral to *C. dakotensis*. The very advanced character of the upper cheek teeth of *C. dakotensis* tends somewhat to confirm the hypothesis (first expressed by Peterson in 1920) that *Menoceras cooki* is derived from this line of smaller forms, instead of being a stunted off-shoot of the *Subhyracodon*-*Diceratherium* line. However, a new alternative now seems about equally plausible—that *Menoceras cooki* is an off-shoot of the European *Pleuroceros* group. This suggestion is based partly on similarities in the molar protocones,

partly on the lack of definite evidence for North American origin. There does not seem to be any valid a priori objection to *Menoceras* being independent of *Diceratherium*. *Menoceras* was probably a much more cursorial form (Wood, 1927, p. 58 and Table VII). Median horns have arisen independently in related lines of true rhinoceroses in identical positions. In the same way, paired horns have developed independently in *Colonoceras* and *Metahyrachyus*, in *Diceratherium armatum* (with its relatives), in *Pleuroceros* ("*Diceratherium*") *pleuroceros* (Duvernoy), and in *Pleuroceros* ("*Diceratherium*") *asphaltense* (Depéret and Douxami)—new combination. There is, therefore, no reason to assume that the paired horns of *Menoceras cooki* can not be an independent parallel specialization.

In this connection, it may be of interest to point out that Ringström (1924, 1927) refers certain of his Pontian and later Asiatic rhinoceroses to the genus *Diceratherium*. However, he specifies that it is a provisional correlation, using "*Diceratherium*" as a broad genus to include the European forms with paired horns (following Osborn and Depéret), for which I am reviving the name *Pleuroceros* Roger. (Incidentally, Palmer in his "Index Generum Mammalium" regards *Pleuroceros* Roger (1898) as preoccupied by *Pleuroceras* Hyatt (1868); but, according to the "International Rules of Zoological Nomenclature," article 36, this is not the case, and Roger's name is available). Whether Ringström's forms are congeneric even with *Pleuroceros* from the Oligocene (Stampian and Aquitanian) may be open to considerable doubt. I should place them, provisionally, among the Teleocerinae, keeping *Pleuroceros* in mind as a possible alternative. But they are certainly not related to *Diceratherium* (strictu sensu). Since writing this discussion of *Diceratherium*, I have received a paper from Borissiak (1927) in which he expresses the opinion that the European "diceratheres" are distinct from the aceratheres and perhaps from the American diceratheres.

In my former paper (Wood, 1927, p. 71) I failed to point out adequately that the recognition of a definite well preserved specimen of *Diceratherium armatum* in the Protoceras Beds of South Dakota helps to tie up the Great Plains succession with the John Day of the Pacific coast, and checks with previous ideas as to their correlation: that is, the lower John Day is roughly equivalent to the Protoceras Beds. On page 32 of this paper the fourth sentence in the second paragraph should read: "There are no internal cingula on P<sup>3</sup>, M<sup>1</sup>, or M<sup>2</sup>. On the outer faces of P<sup>3</sup> and M<sup>1</sup>, the metacone forms a well defined rib." I

am indebted to Dr. W. O. Dietrich, of Berlin, for calling my attention to the substitution of "single" for "simple" on page 83, line 4. Pages 86 and 87 are interchanged. In the chart (figure 1), I called *Menoceras cooki* and *Diceratherium niobrarense* "Upper Miocene." Actually, they are from the Upper Harrison, which would not generally be regarded as above the middle of the American continental Miocene, if that high. The relative levels of the various species are, however, correctly indicated. Prof. A. S. Romer of Chicago, very kindly called this to my attention.

In two papers (1926 and 1928) Dr. W. D. Matthew gives his most recent views, with phyletic trees, on the interrelationships of the main groups of perissodactyls. In their major outlines, I believe these trees represent an important advance. I am, however, totally unable to agree with placing even primitive amynodonts as ancestral to the true rhinoceroses. Neither the stratigraphic nor the morphological evidence would seem to accord with this view. I am also in partial disagreement with his opinions on the interrelationships of the Oligocene rhinoceroses (1928, p. 980, footnote).

#### SUMMARY

1. The traditional view that *Subhyracodon occidentale*, rather than *S. trigonodum*, gave rise to the later species of that genus, as well as to *Diceratherium* (strictu sensu), is now pretty definitely established.

2. *Caenopus dakotensis* Peterson, a small form, rather progressive for its time, and related to *C. mitis*, is now definitely established.

3. The ancestry of *Menoceras cooki* is still uncertain.

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## DESCRIPTION OF A NEW RED SQUIRREL FROM NORTH CAROLINA

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Specimens of the red squirrel from the higher parts of the southern Appalachians have been in the U. S. National Museum collection for many years, and have been recognized as belonging to a distinct race by several of our local mammalogists. On a recent visit to the mountains of North Carolina, I was impressed with the unusual conditions prevailing in the "cloud forests" of the higher peaks, where in the heavy spruce and fir forests these squirrels make their home. Apparently this region of heavy precipitation and almost daily fogs has produced a race darker than any of the other races of eastern North America.

### *Sciurus hudsonicus abieticola* subsp. nov.

*Type*, ♀ adult, skin and skull, No. 193,638, U. S. National Museum, ( $\frac{2}{3} \frac{2}{3} \frac{2}{3}$  Merriam collection); Highlands, North Carolina, March 9, 1886; C. L. Boynton, collector; original number, 30.

*Subspecific characters*.—Similar to *Sciurus h. loquax*, but distinctly darker on head and sides, and the red of dorsal area a deeper shade; underparts in winter more grayish (less clear white) and more or less vermiculated with dusky (as in *hudsonicus*); skull averaging slightly larger than that of *loquax*.

*Description of type* (in winter pelage).—Ears and median dorsal area, from crown of head to base of tail, burnt sienna (of Ridgway, 1912), mixed with ochraceous-buff; sides mixed fuscous and ochraceous-buff (the general tone near buffy brown), bordered next the belly with a black stripe; nose and fore part of head between the eyes fuscous, mixed with ochraceous-buff; sides of head and face mouse gray; eye ring white; underparts grayish-white, vermiculated with hair-