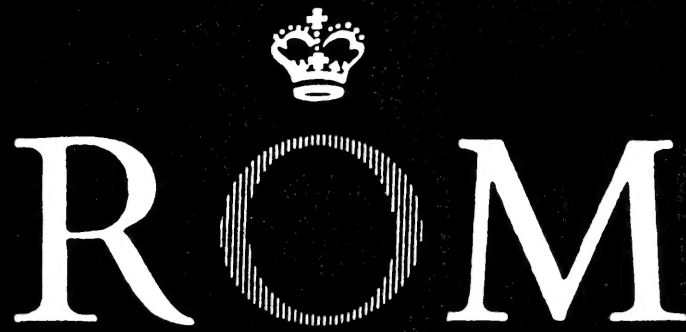


Tertiary Mammals
of Saskatchewan
Part VI: The Oligocene
Rhinoceroses

Loris S. Russell



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LORIS S. RUSSELL

Tertiary Mammals
of Saskatchewan
Part VI: The Oligocene
Rhinoceroses


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Tertiary Mammals of Saskatchewan

Part VI: The Oligocene Rhinoceroses

Abstract

Dissociated skulls and lower jaws of rhinocerotoid perissodactyls are described from the Cypress Hills Formation (Lower Oligocene) of the Cypress Hills, Saskatchewan. Most of these are from the Hunter Quarry, on Calf Creek, but other good specimens come from a locality northwest of Southfork Station. The following species are recognized: two species of *Hyracodon*; at least two, and possibly five species of *Trigonias*; and a new species of *Subhyracodon*. Two species are referred with question to *Caenopus*. The specimens are in the collections of the National Museum of Natural Sciences, Ottawa, the Saskatchewan Museum of Natural History, Regina, and the Royal Ontario Museum, Toronto.

Introduction

Rhinocerotoid perissodactyls from the Cypress Hills Formation of Saskatchewan have been known since 1885, when E.D. Cope listed and briefly described fossil mammals collected by R.G. McConnell and T.C. Weston in the Cypress Hills, District of Assiniboia, North-West Territory. In 1891 Cope gave a more adequate description of the fauna, with good illustrations. Rhinocerotid material in the collection was assigned to *Caenopus occidentalis* (Leidy) and *C. pumilus* (Cope). Lawrence Lambe made an additional collection in 1904, and described *Hyracodon priscidens*, sp. nov., in 1906. In 1908 Lambe published a full description of the fauna and assigned the rhinocerotoid material to *Hyracodon nebrascensis* Leidy, *H. priscidens* Lambe, *Aceratherium mite* Cope, *A. occidentalis* (Leidy), *A. exiguum*, sp. nov., and ?*Leptaceratherium trigonodon* Osborn and Wortman.

No further account of the Cypress Hills fauna was attempted until 1934, when L.S. Russell published a short revision of the known material, including a collection made by W.E. Cutler for the British Museum (Natural History). Russell listed the rhinocerotoids as follows: *Hyracodon nebrascensis* Leidy, *H. arcidens priscidens* Lambe, *H. browni*, sp. nov., *Caenopus mitis* (Cope), *Subhyracodon occidentalis* (Leidy), and *S. trigonodus* (Osborn and Wortman).

More recent collections that have been studied by the writer include those of Fenley Hunter, 1936 and 1937, for the National Museum of Canada; L.S. Russell, 1939, for

the Royal Ontario Museum, and 1951, for the National Museum of Canada; G.E. Lindblad, 1952, for the National Museum of Canada; Bruce McCorquodale and A.E. Swanston, 1951, 1960 to 1962, for the Saskatchewan Museum of Natural History; A.G. Edmund, 1967 and 1968, and Gordon Gyrnov, 1972, for the Royal Ontario Museum. Most of these collections came from the Hunger Quarry, the location and history of which has been described elsewhere (Russell, 1972:3, 4). In brief, it is located on the east side of Calf Creek, in legal subdivisions 5 and 12, section 8, township 8, range 22, west of the 3rd meridian. The fossil-bearing deposits, which vary from poorly consolidated sand to indurated conglomerate, lie 18 or more metres above the contact of the Cypress Hills Formation on the Ravenscrag Formation (Palaeocene).

In 1962 Swanston discovered a new locality and mode of preservation for Cypress Hills mammals in road cuts northwest of Southfork station, southwest quarter, section 2, township 8, range 21, west of the 3rd meridian. The specimens were preserved in whitish bentonitic sandstone, and include important rhinocerotoid material.

The present account is based mainly on the Saskatchewan Museum and Royal Ontario Museum collections. In some cases systematic determination is not precise, as the specimens, even though well preserved, may not include the particular parts on which diagnoses have been based (e.g., the upper premolars). The policy in this study has been to provide detailed descriptions with illustrations of all good specimens, leaving more precise systematic determination for the time when additional, more diagnostic, material is available.

Systematic Description

Order Perissodactyla Owen, 1848
Superfamily Rhinoceroidea Gill, 1872
Family Hyracodontidae Cope, 1879

FAMILY CHARACTERS

Small to medium-sized rhinocerotoid perissodactyls with slender body proportions but relatively large head. Dentition rhinoceros-like but relatively primitive, and almost complete. Skull with well-developed sagittal crest. Manus and pes tridactyl.

REMARKS

If the Late Eocene genus *Triplopus* be excluded from this family, the only remaining genera are *Hyracodon* of the Oligocene and *Prothyraodon* Scott and Osborn of the Late Eocene.

Hyracodon Leidy, 1856

GENERIC CHARACTERS

Dentition $\frac{3 \ 1 \ 4 \ 3}{3 \ 1 \ 3 \ 3}$. Upper incisors and canines simple, pointed, and slightly recurved, with no diastemata. Long post-canine diastema. Upper premolars

progressively more molariform from P¹ to P⁴, but all with distinct buccal cingulum; metaloph relatively short, tending to join postprotoloph with wear. M¹ and M² subquadrate, with small crista and antecrochet; M³ trianguloid, but with ectoloph extended posterad beyond juncture with metaloph, as in M¹ and M². Lower incisors and canines also forming continuous series, progressively larger from I₁; more chisel-like and less recurved than corresponding upper teeth. P₂ submolariform; P₃ and P₄ molariform but with buccal cingulum more distinct than on molars. Lower molars characteristically rhinocerotoid.

TYPE

Rhinoceros nebraskensis Leidy, 1850

Hyracodon priscidens Lambe, 1906

TYPES

National Museum of Natural Sciences (NMC) 6564, holotype (Fig. 1), left and right maxillae of same individual, with left P¹ to P³, right P¹, P², and P⁴, and left and right M¹ to M³. NMC 6561, plesiotype (Fig. 2), mandibular symphysis with part of left ramus, roots of all incisors and canines, and well-preserved left P₂ to P₄. From "Bone Coulee" (Conglomerate Creek valley), Cypress Hills, Saskatchewan.

REFERRED SPECIMENS

Saskatchewan Museum of Natural History (SMNH) P1634.1 (Figs. 3, 4), incomplete mandible with left and right P₃ to M₃, and alveoli for I₁ to I₃, C, and P₂; Calf Creek. Royal Ontario Museum (ROM) 23195 (Fig. 5), mandibular fragment with part of symphysis, and left and right P₂ to M₁, Hunter Quarry.

SPECIFIC CHARACTERS

Teeth relatively low crowned. Upper premolars with protoloph curving around through protocone to hypocone and almost to posterior cingulum; metaloph reaching protoloph on P¹ and P², not on P³ and P⁴; cingulum distinct and complete on anterior, lingual, and posterior sides. On M³, posterior extension of ectoloph short, and bent abruptly to point posterad, rather than continuing the line of ectoloph posterolingual. In lower dentition, P₂ narrows anterad, with short protolophid directed anterolingual rather than lingual; P₃ to M₃ very similar in size and crown pattern, but premolars having a more nearly continuous lingual cingulum than that of the molars.

DESCRIPTION

Lambe's account of the holotype is clear and comprehensive, and his illustrations are elegant (from his own drawings), so it is unnecessary to give a full description here. One or two comments are in order, however. For instance, Lambe (1908:41) mentions a "delicate crochet" on P⁴; this is a tiny spur projecting anterolingual from the free terminal of the metaloph. It may be an individual character, because the same

thing occurs on a skull of *Trigonias* (SMNH P1635.2) on the left P⁴ but not on the right.

Lambe (1908:42) noted the long postcanine diastema on his plesiotype. On SMNH P1634.1 the gap between canine and P₂ alveoli is not as great, but still relatively longer than in *H. nebraskensis*. On SMNH P1634.1 the left ramus has a small, shallow pit on the buccal slope of the dorsal rim, closer to the alveolus of P₂ than to that of the canine, but well separated from both. The right ramus is broken at this point, but still shows a faint groove that may be the remnant of the corresponding pit. I interpret this pit as the vestige of the alveolus for a very juvenile or prenatal DP₁, something *Hyracodon* is not supposed to have.

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
NMC 6564, holotype		
Left P ² to M ³	117.2	—
Left P ¹	12.2	13.1
Left P ²	16.0	18.5
Left P ³	16.7	20.8
Right P ⁴	17.2	22.7
Left M ¹	21.2	22.9
Left M ²	23.7	26.2
Left M ³	19.7	22.6
NMC 6561, plesiotype		
Left P ₂	13.3	10.4
Left P ₃	15.7	12.6
Left P ₄	17.8	14.1
SMNH P1634.1		
Left P ₂ to M ₃	93.0	—
Left P ₂ alveolus	14.6	18.2
Left P ₃	18.2	12.8
Left P ₄	18.0	14.7
Left M ₁	17.8	12.5
Left M ₂	21.2	13.3
Left M ₃	+19.3	13.2
ROM 23195		
Left P ₂	15.7	10.9
Left P ₃	18.3	12.6
Left P ₄	22.9	12.7
Right M ₁	19.0	12.8
Left M ₂	22.5	12.3

REMARKS

Sinclair (1922) recognized four “types” or species of *Hyracodon*, based on the progressive molarization of the upper premolars. The first “type”, *H. arcidens*

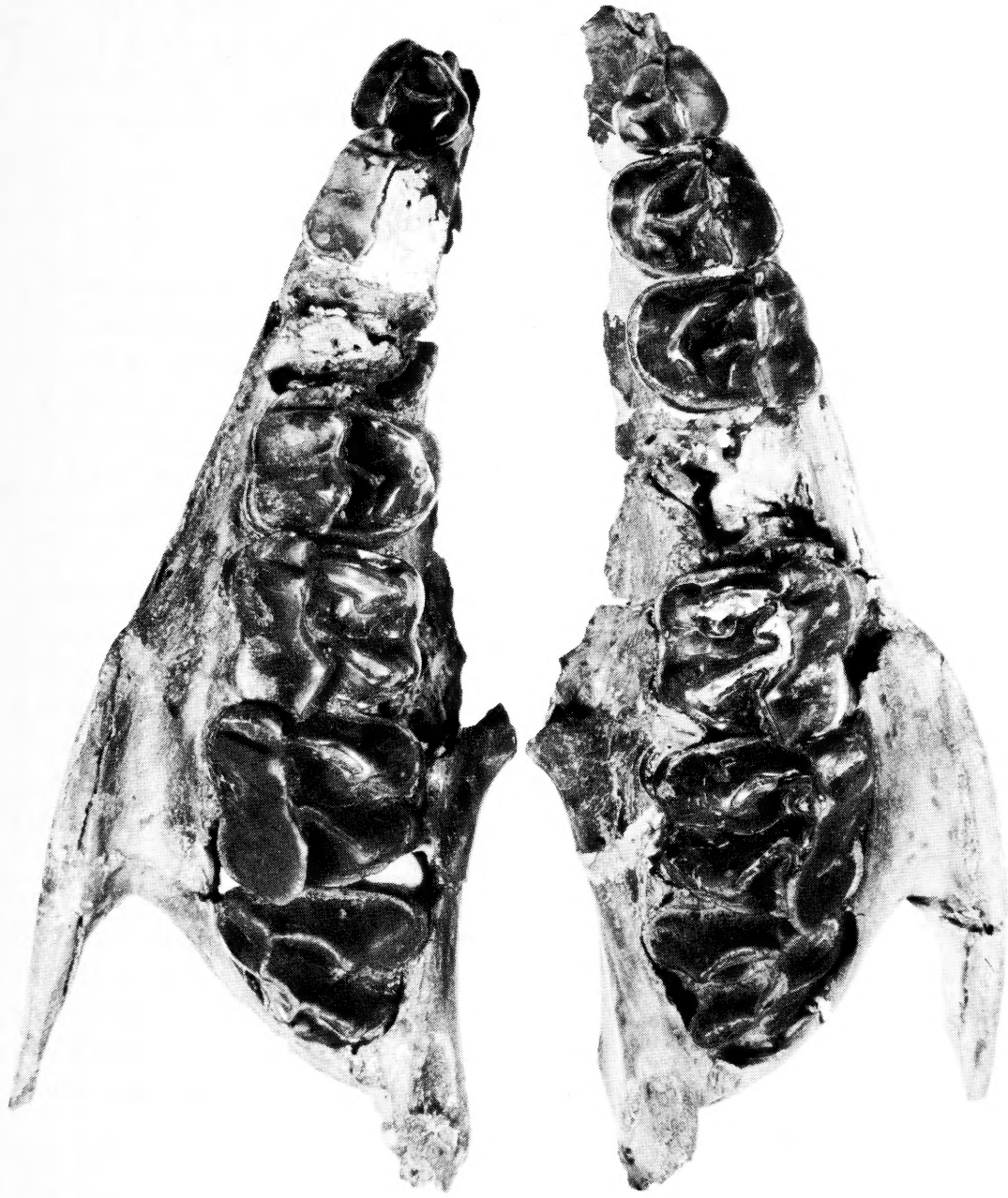


Fig. 1 *Hyracodon priscidens* Lambe, holotype, NMC 6564, incomplete right and left maxillae with right P¹, P², P³, P⁴, M¹, M², M³, and left P¹, P², P³, M¹, M², M³; occlusal view, $\times 1$.



Fig. 2 *Hyracodon priscidens* Lambe, plesiotype, NMC 6561, incomplete left mandibular ramus with symphysis with left P₂ to P₄; occlusal view, × 1.

Cope, is characterized by having the protoloph curving around the lingual end of the metaloph but not connected to it in the unworn condition. This broadly describes the structure of the P⁴ (and P³) in *H. priscidens*, and Sinclair definitely regarded Lambe's species as a synonym of *H. arcidens*. Wood (1928) also placed *H. priscidens* in *H. arcidens*, although recognizing that the former was less "progressive" in the structure of the upper premolars. Scott (1941) dismissed these variations in the upper premolars as subspecific, and placed all of the described species of *Hyracodon* within *H. nebraskensis* (Leidy).

Comparison of Lambe's holotype with Sinclair's figure of *H. arcidens* and Wood's (1926) figure of *H. petersoni* shows that the structure of P³ and P⁴ in *H. priscidens* is much closer to that of *H. petersoni* than that of *H. arcidens*. The direction of the metaloph and its abrupt termination indicate that even in well-worn teeth the metaloph would not close off the median valley. In *H. arcidens* (Sinclair, 1922, fig. 1), the metaloph joins the protoloph at an early stage of wear, and the protoloph does not extend posterad of the junction. In another feature, the posterad extension of the ectoloph on M³, *H. priscidens* is more like *H. petersoni* than *H. arcidens*.

In conclusion, *H. priscidens* and *H. petersoni* are as distinct from *H. arcidens* as that species is from *H. nebraskensis*. But there is still some uncertainty about the nomenclature, owing to the question of what is the holotype of *H. arcidens* (Sinclair, 1922: 68). I shall leave this problem to those who have access to larger collections of White River specimens of *Hyracodon*, merely pointing out that *H. priscidens* is distinct specifically from *H. arcidens* Cope, as the latter is presently understood.

Hyracodon petersoni Wood, 1926

TYPE

Carnegie Museum, Cat. Vert. Foss. No. 3572, incomplete maxillae and premaxillae, with most of the dentition. Chadron Formation, Sioux County, Nebraska.



Fig. 3 *Hyracodon priscidens* Lambe, SMNH P1634.1, incomplete mandible with P₃ to M₃ and alveoli for I₁ to I₃, C, and P₂; left lateral view, × 1.



Fig. 4 *Hyracodon priscidens* Lambe, SMNH P1634.1; occlusal view, $\times 1$.

REFERRED SPECIMENS

SMNH P1179.1, right maxillary fragment with deeply worn P³ to M³. SMNH P1179.2 (Fig. 6), right maxillary fragment with P³ to M³, the M¹ deeply worn, other teeth well worn. SMNH P1204.1 (Figs. 7, 8), incomplete mandible with I₁, I₂, and alveolus for I₃, both C, right P₂ to M₃, left P₃ to M₃. All specimens from the Southfork locality.



Fig. 5 *Hyracodon priscidens* Lambe, ROM 23195, mandibular fragment with part of symphysis, with left P₂ to P₄ and right P₂ to M₁; occlusal view, × 1.



Fig. 6 *Hyracodon petersoni* Wood, SMNH P1179.2, right maxillary fragment with P³ to M³; occlusal view, × 1.

SPECIFIC CHARACTERS

Relatively small and slender. P² with hypocone connected directly to protocone and metaloph. P³ and P⁴ with hypocone connected to protocone, but with lingual end of metaloph curving posterad to leave a wide opening between it and hypocone; distinct cingulum on buccal slope of metacone. M³ with short posterior extension of ectoloph projecting posterad.

DESCRIPTION

The dentition of P1179.2, although worn, is better preserved than that of P1179.1. P³ is well worn but some crown structure is still visible. The metaloph is confluent with the hypocone crest, but the nature of the junction suggests that the two crests were separate when unworn. On P⁴ the crown is less worn, and the tip of the metaloph curves posterad to avoid the hypocone. Both premolars have a cingulum on the buccal side of the metacone, and an almost continuous lingual cingulum. On M¹ the crown structure is obliterated by wear. M² is in about the same stage of wear as P⁴; the posterior extension of the ectoloph is short and points posterad. There is an antecrochet on the posterior side of the protoloph. Both M¹ and M² have a short buccal cingulum on the metacone. M³ has a short posterad extension of the ectoloph, and a rudiment of a crista.

The mandible, P1204.1, is tentatively referred to this species because the size and proportions are appropriate to the two maxillary fragments. The coronoid, condyle, and angle are missing on both sides. The I₁ is peglike, but both have lost the crown. I₂ has a peglike root but a wedge-shaped crown, the edge orientated obliquely. I₃ is represented by a small, compressed alveolus. The C has a long cylindrical root and a short, conoid crown; it is directed almost vertically, with only a slight recurve. The diastema between C and P₂ is about equal in length to P₃; the mandibular rim here is broadly indented in both vertical and horizontal profile; the symphysis internally is troughlike, and extends posterad to the midlength of P₂. That tooth has a trianguloid crown, with the ectolophid terminating anteriorly in a small cuspid, and with two short transverse lophids posteriorly, the valley between being open lingually. P₃ is almost molariform, except that the trigonid is narrower than the talonid. P₄ is molariform, but like P₃ has a strong buccal and weak lingual cingulum. M₁ is deeply worn, but appears to have been similar to M₂. That tooth is less worn, and shows that the anterior arms of the protolophid and hypolophid are orientated slightly anterlinguad, rather than directly anterad as in *H. nebraskensis* and *H. priscidens*. M₃ is similar, and, being moderately worn, shows a more angulate crest at the hypoconid than in the other two species; the parastylid is slightly recurved.



Fig. 7 *Hyracodon petersoni* Wood, SMNH P1204.1, incomplete mandible with I₁, I₂, and alveoli for I₃, both C, left P₃ to M₃, right P₂ to M₃; left lateral view, × 1.



Fig. 8 *Hyracodon petersoni* Wood, SMNH P1204.1; occlusal view, $\times 1$.

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
SMNH P1179.2		
Right P ³ to M ³	80.1	—
Right P ³	14.0	18.0
Right P ⁴	15.7	20.4
Right M ¹	17.0	18.7
Right M ²	19.5	20.8
Right M ³	16.8	19.2
SMNH P1204.1		
Left I ₂ to M ₃	133.3	—
Left I ₂ , crown	5.1	6.3
Left C, at base of crown	6.7	5.9
Right P ₂	12.6	8.8
Left P ₃	14.9	12.0
Left P ₄	15.3	11.9
Left M ₁	13.8	12.1
Left M ₂	19.5	12.9
Left M ₃	19.9	13.1

REMARKS

It is difficult to recognize valid distinctions in the upper dentition between *H. petersoni* and *H. priscidens*. Apart from the smaller size of *H. petersoni*, there is the metaloph of P⁴, which curves posterad at its free end, thus keeping the median valley open until the crown is deeply worn. The posterad extension of the ectoloph on M³ is shorter in *H. petersoni*, and is directed posterad, not posterobuccad.

If the mandible referred tentatively to *H. petersoni* really belongs to that species, some other differences may be noted from *H. priscidens*. These include the relatively narrow cheek teeth, and the slightly more recurved end of the protolophid.

Family Rhinocerotidae Owen, 1845

FAMILY CHARACTERS

Medium to large-sized perissodactyls, most of which have large heads, heavy bodies, and relatively short limbs; the manus is tetradactyl to tridactyl and the pes tridactyl. Various genera since Miocene time have one or two horns of agglutinated hair resting on the nasal bones. The dental formula is $\frac{3-0 \ 1-0 \ 4 \ 3}{2-0 \ 0 \ 4-3 \ 3}$. I¹ when present is in the form of an anteroposterad-orientated, chisel-like blade. Upper and lower premolars are submolariform to molariform except P₁¹, which are smaller and simpler. M¹ and M² have quadrate crowns, with buccal margin formed by strong ectoloph, which gives rise to transverse protoloph and metaloph, and extends posterad of metaloph; M³ is trianguloid, the posterobuccal margin formed by continuous ectoloph and metaloph. Lower molars with trigonid and talonid each with L-shaped crest, that of

trigonid formed by anterad protolophid and linguad metalophid, and that of talonid by anterad hypolophid and linguad entolophid; the hypolophid does not reach the metaconid; M₃ without a hypoconulid spur.

Trigonias Lucas, 1900

GENERIC CHARACTERS

Relatively primitive rhinocerotids of medium size. Dentition $\frac{3 \ 1 \ 4 \ 3}{2 \ 0 \ 4 \ 3}$. Chisel shape

of I¹ moderately developed. Upper premolars highly variable, ranging from those with lingual ends of protoloph and metaloph joined, to those in which the two crests are quite separate lingually, as in the molars; P² is usually the most molariform. Upper molars, and lower premolars and molars, are characteristically rhinocerotid. Manus tetradactyl.

Trigonias osborni Lucas, 1900

REFERRED SPECIMENS

ROM 1733 (Fig. 9), incomplete left maxilla with P¹ to M¹. ROM 5920 (Fig. 10), incomplete right maxilla with P¹ to M¹. Both from the Hunter Quarry.

SPECIFIC CHARACTERS

Unworn upper premolars (P²-P⁴) with hypocone not connected to protocone or metaloph; with wear, hypocone unites with protocone before joining metaloph, leaving median valley open posteriorly; no hypostyle. M³ with slight angle at junction of ectoloph and metaloph. Lingual cingulum present on upper premolars but not on molars.

DESCRIPTION

The following account is based on ROM 1733. P¹ has a shallow, broad lingual re-entrant. P² to P⁴ are moderately worn. P² has the anterior arm of the protocone not reaching the ectoloph (paracone), but the posterior arm is narrowly connected to the metaloph and the posterior side of the hypocone; hypocone and metaloph are narrowly separated; lingual margin of crown is not oblique. P³ is like P² but larger, and relatively wider; the protoloph is connected to the ectoloph, but the protocone, hypocone, and lingual end of metaloph are all well separated from each other; the lingual margin of the crown is oblique, curving posterobuccad around the hypocone. P⁴ is very similar to P³ but distinctly wider buccolingually; the free lingual end of the metaloph is bifid; the hypocone is relatively small and is connected to the cingulum; the lingual margin of the crown is more oblique than that of P³. M¹ is more worn than P⁴; there is a trace of a lingual cingulum between protocone and hypocone.



Fig. 9 *Trigonias osborni* Lucas, ROM 1733, incomplete left maxilla with P¹ to M¹; occlusal view, × 1.

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
ROM 1733		
Left P ¹ to M ¹	103.6	—
Left P ¹	19.6	13.2
Left P ²	19.5	22.8
Left P ³	21.0	28.7
Left P ⁴	24.3	34.2
Left M ¹	29.4	34.9

REMARKS

The structure of the upper premolars, especially P², is very similar to that of *Trigonias taylori* Gregory and Cook (1928), particularly in the short metaloph, which is free or almost free from the hypocone and the more or less isolated hypocone. Wood (1931) and Scott (1941) recognized *T. taylori* as a distinct species, but it seems to me to be in the same status as the numerous other “species” or “subspecies” described by Gregory and Cook (1928) from Colorado, which are all interrelated by the highly variable structure of the upper premolars. If *T. taylori* is to be recognized as a valid species or subspecies, the Cypress Hills specimens should be assigned to that taxon.

Trigonias ?osborni Lucas, 1900

REFERRED SPECIMENS

SMNH P1637.1 (Fig. 11), right maxilla and portion of jugal, with P² to M³; Calf Creek. SMNH P1637.2 (Fig. 12), left maxillary fragment with P¹ to M¹; Calf Creek. SMNH [no number] (Fig. 13), left mandibular ramus with symphysis, left P₁ to M₃, right I₁ and I₂; Hunter Quarry.



Fig. 10 *Trigonias osborni* Lucas, ROM 5920, incomplete right maxilla with P¹ to M¹; occlusal view, X 1.



Fig. 11 *Trigonias osborni* Lucas, SMNH P1637. 1, right maxilla and portion of jugal, with P² to M¹; occlusal view, × 1.



Fig. 12 *Trigonias ?osborni* Lucas, SMNH P1637.2, left maxillary fragment with P¹ to M¹; occlusal view, × 1.

DESCRIPTION

SMNH P1637.1 has the teeth somewhat cracked but otherwise well preserved. P² is very molariform, with well-developed protoloph and metaloph extending linguad from ectoloph and terminating in protocone and hypocone, respectively, near the lingual margin; there is a slight connection between the two cusps; the cingulum is strong, and continues from anterior around lingual to posterior margin of the crown. P³ is less molariform; the protoloph continues into the large protocone, from which the crest extends posterad into the hypocone; the metaloph, in contrast, is short, and ends abruptly buccal of the hypocone, leaving a posterior opening for the median valley; the cingulum is similar to that of P² but there is a slight interruption at the base of the protocone; the lingual margin of the crown is oblique. P⁴ is wider, but not much longer than P³; it has a continuous crest, consisting of protoloph, protocone, hypocone, and metaloph, enclosing the median valley; the cingulum is well interrupted on the lingual slope of the protocone, and the posterolingual margin of the crown is very oblique. M¹ and M² are similar to each other, with strong ectoloph bearing a prominent paracone, a slight parastyle, and a long posterad extension beyond the metacone; the oblique protoloph and metaloph are prominent, and there is a faint suggestion of an antecrochet on M¹; a minute trace of cingulum is visible between protocone and hypocone on M¹ but not on M². M³ is not quite fully erupted; it has a prominent paracone posterior to junction of protoloph with ectoloph; the latter crest then turns abruptly posterolinguad parallel with the protoloph, and with a very slight angulation continues as a short metaloph.

SMNH P1637.2 is slightly smaller than P1637.1, but otherwise resembles it closely. The P¹ has a large re-entrant from the anterolingual margin. P² is molariform, as in P1637.1, but there is a cleft between the buccal end of the protoloph and the parastyle portion of the ectoloph. A similar difference exists between the otherwise similar P³ of the two specimens. P⁴ of P1637.2 also has the cleft, and the metaloph does not reach the hypocone, leaving the median valley open posterad as in P³. The M¹ is similar to that tooth in P1637.1, but the antecrochet is a little more distinct.



Fig. 13 *Trigonias ?osborni* Lucas, SMNH, left mandibular ramus with symphysis, right I₁ and I₂, left P₁ to M₃; occlusal view, × 0.6.

The uncatalogued SMNH mandible has a long, shallow symphysis reaching back to P₂. The incisors are typical, that is, small, knob-shaped I₁, and large, procumbent I₂; there appears to be a remnant of the alveolus of I₃. The P₁ is a small anteroposterior blade with a large middle cusp and small anterior and posterior cusps. P₂ is larger and more trianguloid, with the beginning of a talonid and a hypolophid. P₃ and P₄ are almost molariform, except that the metalophid is much higher than the talonid. The molars have the trigonid crest more angulate than that of the talonid, which is almost crescentic. M₃ is barely erupted and quite unworn.

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
SMNH P1637.1		
Right P ² to M ³	163.3	—
Right P ²	21.9	28.6
Right P ³	24.6	31.4
Right P ⁴	25.4	37.6
Right M ¹	32.2	37.0
Right M ²	38.5	43.5
Right M ³	34.6	40.1
SMNH P1637.2		
Left P ¹ to M ¹	113.2	—
Left P ¹	18.6	13.6
Left P ²	21.0	22.0
Left P ³	22.8	28.1
Left P ⁴	24.9	32.9
Left M ¹	34.7	36.8
SMNH [no number]		
Left P ₁ to M ₃	163.1	—
Left P ₁	13.3	8.0
Left P ₂	16.6	11.4
Left P ₃	19.6	15.0
Left P ₄	20.9	16.7
Left M ₁	27.1	19.6
Left M ₂	33.2	21.4
Left M ₃	36.2	21.2

REMARKS

These three specimens are very close to, if not conspecific with, *Trigonias osborni*. In the case of the upper dentitions the premolars do not show quite the same combination of cusps and crests seen in the type of *T. osborni*, although it is closer than to that of any other of the supposed species. Also the size is somewhat small for *T. osborni*. In the lower dentition the smaller size is almost the only difference from the corresponding teeth of typical *T. osborni*.

Trigonias, cf. osborni Lucas, 1900

REFERRED SPECIMENS

ROM 23182 (Fig. 14), incomplete skull with left I³, C, P¹ to M³, and right I², P¹ to M³. ROM 5933, right P³. ROM 5923, right P³ or P⁴. ROM 5922, left M¹ or M². All from the Hunter Quarry.

DESCRIPTION

The incomplete skull, ROM 23182, is badly shattered and not fully prepared, but has a nearly complete dentition. The right I² is a small blunt cone. The left I³ and C are represented by stumps. The diastema between the alveolus of C and the P¹ is of about the same length as the P¹. The latter tooth is ovoid in outline, with a well-developed main cusp and an anterior ridge; lingual to the main cusp is a short marginal crest; the posterior part of the tooth is broader and shelf-like, with a curved crest like a metaloph, much worn. P² is molariform, but the protoloph dies away buccally before reaching the ectoloph, and there is no connection between protocone and hypocone; the metaloph is continuous from ectoloph to hypocone, and is slightly crescentic, concave posteriorly; the lingual cingulum is briefly interrupted on the protocone slope. P³ is submolariform; the crown outline narrows linguad; the protoloph is a prominent crest, which does not quite reach the ectoloph, but continues posterad from the protocone to the hypocone; the metaloph arises from the ectoloph, but terminates, with a slight posterad curvature, well short of the hypocone, leaving a wide opening to the median valley; the lingual cingulum is interrupted at the base of the protocone. P⁴ is wider than P³ but about the same in length; it too narrows linguad; the protoloph originates on the lingual wall of the ectoloph and is connected to a prominent protocone, posterior to which the crest drops gradually to the cingulum, with only a vestige of the hypocone on the left tooth and none on the right; the metaloph is shorter than on P³ and the gap between it and the protoloph is wider; this tooth is not fully erupted. M¹ has only a faint antecrochet and M² none at all. M³ is just emerging through the rim of the alveolus; the ectoloph is short and the protoloph and metaloph are approximately parallel.

As mentioned under referred specimens, there are three isolated teeth in the ROM collection that are best treated under *Trigonias, cf. osborni*. ROM 5933 is a slightly broken right P³, of about the same size as the corresponding tooth on ROM 23182. It has the same oblique posterolingual margin and the continuous lingual cingulum. At this stage of wear the buccal end of the protoloph has not yet merged with the ectoloph. The protoloph continues to the prominent protocone, then turns posterad to terminate in a vestigial hypocone. The metaloph is joined to the ectoloph at the paracone; it is short, and curved slightly posterad, leaving a gap between its free end and the hypocone.

ROM 5923 is a larger tooth than ROM 5933, but shows an almost identical crown pattern. The lingual margin is a little more oblique than that of ROM 5933. The buccal end of the protoloph merges with the ectoloph at the anterobuccal corner of the crown. The protocone is prominent, and connected to the vestigial hypocone. The metaloph is short; it is orientated parallel to the protoloph, but does not meet the hypocone.

ROM 5922 is an incomplete molar, probably M¹ because of the presence of a rounded antecrochet on the protoloph. It closely resembles the corresponding teeth of ROM 23182.

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
ROM 23182		
Left P ¹ to M ³	±154.6	—
Left M ¹ to M ³	±83.5	—
Left P ¹	14.5	12.5
Left P ²	18.3	21.2
Left P ³	22.2	28.8
Left P ⁴	23.2	30.6
Left M ¹	30.3	34.4
Left M ²	33.5	38.7
ROM 5933		
Right P ³	—	29.3
ROM 5923		
Right P ⁴	22.0	30.0
ROM 5922		
Left M ¹	—	+34.4

REMARKS

The teeth of ROM 23182 resemble those of *Trigonias gregoryi* as described by Wood (1928), particularly in the association of a molariform P² with submolariform P³ and P⁴. *T. gregoryi*, however, is much larger in size. *T. precopei* and *T. preoccidentalis* of Gregory and Cook (1928) also show the combination of molariform P² with submolariform P³ and P⁴. Wood (*in* Scott, 1941) regarded both of these “species” as subspecies or varieties of *T. osborni*. The present material, therefore, would seem to fall within *T. osborni* in the broad sense, but because there is still uncertainty about the species of *Trigonias*, it seems appropriate at this time to designate the incomplete skull as *T. cf. osborni*. As to the three dissociated teeth, they so closely resemble the corresponding teeth of ROM 23182 that it seems proper to give them the same identification.

***Trigonias* species A**

REFERRED SPECIMENS

SMNH P1637.3 (Figs. 15, 16), an incomplete skull, lacking the zygomata and part of the basicranium; preserved dentition consists of left P¹ to M³ and right C to M³; Hunter Quarry.



Fig. 14 *Trigonias*, cf. *osborni* Lucas, ROM 23182, incomplete skull with left I³, C, P¹ to M³, and right I², P¹ to M³; occlusal view, × 0.5.

DESCRIPTION

The crowns of the teeth are well worn to deeply worn. The canine is a miniature tusk, pointed at the tip, swollen to base of crown, and contracting again to the root. The post-canine diastema is about equal in length to the combined lengths of P¹ and P². P¹ is well worn but still shows a main cusp, a large anterior loph curving posterad, and a short metaloph. The pointed tip at the anterior end of the crown is not recurved. P² is deeply worn; what remains of the crown pattern suggests a submolariform status, with the metaloph joining the hypocone and closing off the central basin. The lingual border of the tooth is well rounded. P³ is wider than P²; it is not as severely worn, but the lophs are wide and confluent owing to wear. I interpret this tooth as having had a submolariform pattern, as in ROM 23182, in which the protoloph is continued posterad to the hypocone, and the metaloph does not reach the hypocone. P⁴ is similar to P³, but is wider and has a distinctly oblique posterolingual margin.

M¹ is deeply worn, and there is little vestige of the original crown pattern. The anteroposterior diameter of the crown is noticeably much less than that of the other two molars. M² is less worn, and much of the crown pattern persists. The combined parastyle and paracone form a prominent double-headed cusp. There may have been a rounded antecrochet on the protoloph. M³ is almost as worn as M². As in most rhinoceros dentitions the metastyle of M³ is not conspicuous; the ectoloph passes into the metacone by a broad angle, and continues more or less parallel to the protoloph into the hypocone.

In lateral view, the skull roof is seen to rise moderately to the occiput. The sagittal crest is poorly defined; it diverges anterad into the two superciliary crests of the frontal at a point above the anterior margin of the glenoid fossa.

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
SMNH P1637.3		
From anterior tip of nasals to dorsal rim of occiput	±400.0	—
Right canine, at base of crown	8.7	6.6
Left P ¹	17.1	12.5
Left P ²	18.6	21.2
Left P ³	18.3	28.9
Left P ⁴	22.4	32.7
Left M ¹	28.4	35.4
Left M ²	33.1	37.8
Left M ³	29.8	34.2

REMARKS

With the crown pattern of the premolars almost destroyed by wear, it is impossible to make a definite specific assignment of this specimen. If, as appears probable, the P² was submolariform, then the dentition could fall within the characters of *T. taylori* Gregory and Cook, as illustrated by those authors (1928, pl. V A). However, the skull of that species is described as "brachycephalic", which would exclude P1637.3, so it is identified at this time as a species of *Trigonias*, probably new, but not suitable for definition.



Fig. 15 *Trigonias*, species A, SMNH 1637.3, incomplete skull, with C to M₃; right lateral view, × 0.5.

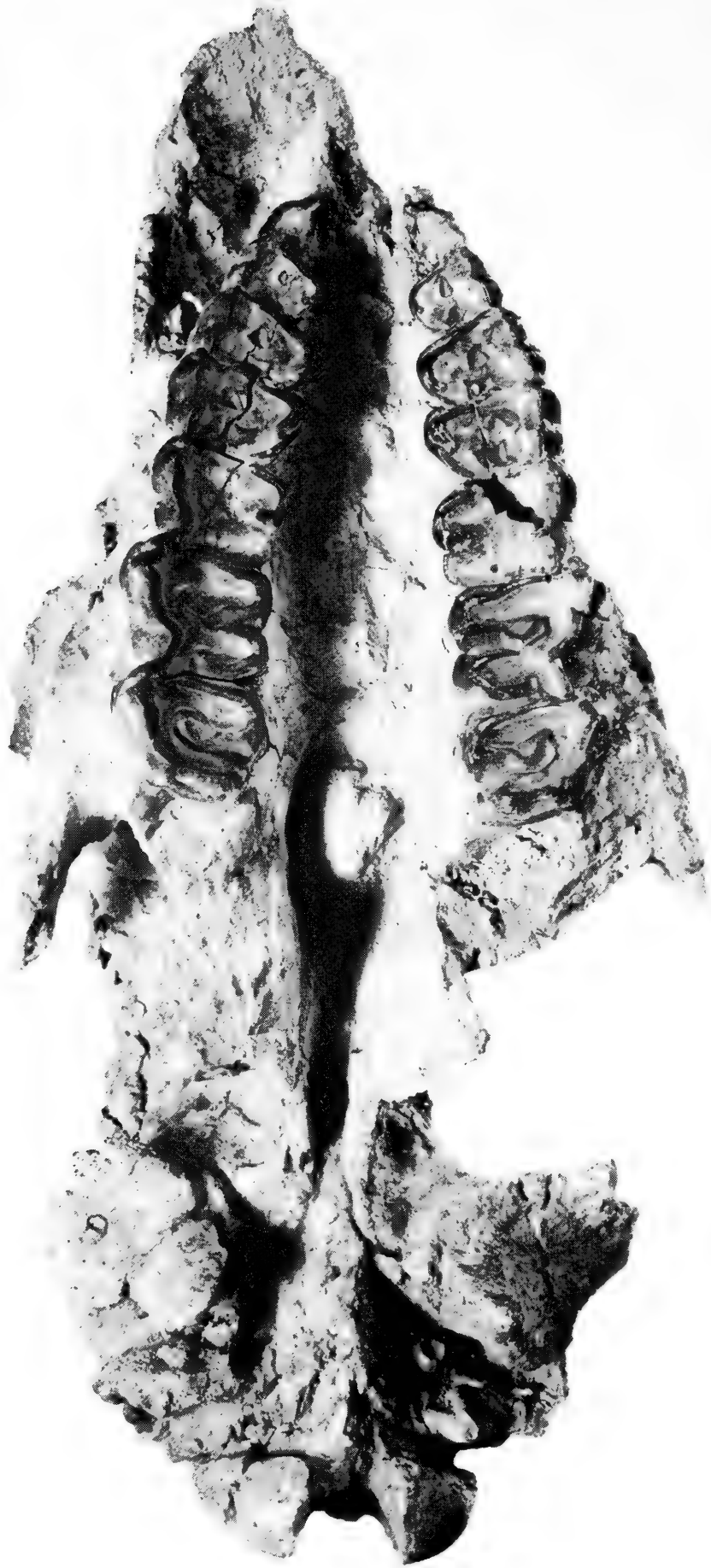


Fig. 16 *Trigonias*, species A, SMNH 1637.3; occlusal view, $\times 0.5$.

Trigonias species B

REFERRED SPECIMENS

ROM 1732 (Figs. 17-19), incomplete skull, with right M¹ to M³; Hunter Quarry.

DESCRIPTION

The skull, as preserved, includes most of the parietals, the right frontal, jugal, and squamosal, posterior part of right maxilla, and the supraoccipitals. In lateral view the dorsal profile is flat for most of its length, but posteriorly it rises prominently to the lambdoidal crest. The crest is not defined. Much of the brain case is preserved, especially on the right side, where traces of the cerebral convolutions are present. There is a large, quadripartite sinus on the inner side of the right frontal.

M¹ and M² are similar to those teeth in *Trigonias* as described by Scott (1941), including the rudimentary antecrochet, and the cingulum restricted to the anterior margin of the crown. M³ also has a cingulum on the posterior margin, with a distinct cuspule at the buccal end; this extends the buccal margin of the crown posterad, but has no connection with the ectoloph. However, Wood (1928:39) suggested that this cuspule was the remnant of the posterior extension of the ectoloph, and therefore a primitive character.

In size the skull is relatively large, compared with other Cypress Hills rhinoceroses. It falls within the range of sizes given by Gregory and Cook (1928), but is smaller than those given by Scott (1941).

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
ROM 1723		
Right M ¹	32.8	38.7
Right M ²	35.9	38.8
Right M ³	31.4	39.5

REMARKS

This specimen falls within the definition of *Trigonias osborni* as given by Wood (1928) and Scott (1941), but in the absence of the premolars it is not possible to exclude it from some other species that have been defined on the basis of premolar structure (Gregory and Cook, 1928). This situation is best expressed by avoiding a specific reference however tentative that might be.

Trigonias species C

REFERRED SPECIMENS

SMNH P1635.1 (Figs. 20, 21), mandible with incomplete left ramus; right I₁, I₂, and alveolus for I₃ and P₁, P₂ to M₃; left I₂, alveolus for I₃, P₁ to incomplete M₃; Calf Creek near Hunter Quarry. ROM 11629 (Fig. 22), incomplete mandible, with alveoli for all incisors, left P₁ to P₄, right P₁ to M₃; Hunter Quarry.



Fig. 17 *Trigonias*, species B, ROM 1732, incomplete skull; dorsal view, $\times 0.5$.



Fig. 18 *Trigonias*, species B, ROM 1732, incomplete skull with right M¹ to M³; right lateral view, × 0.5.



Fig. 19 *Trigonias*, species B, ROM 1732; occlusal view, $\times 0.5$.

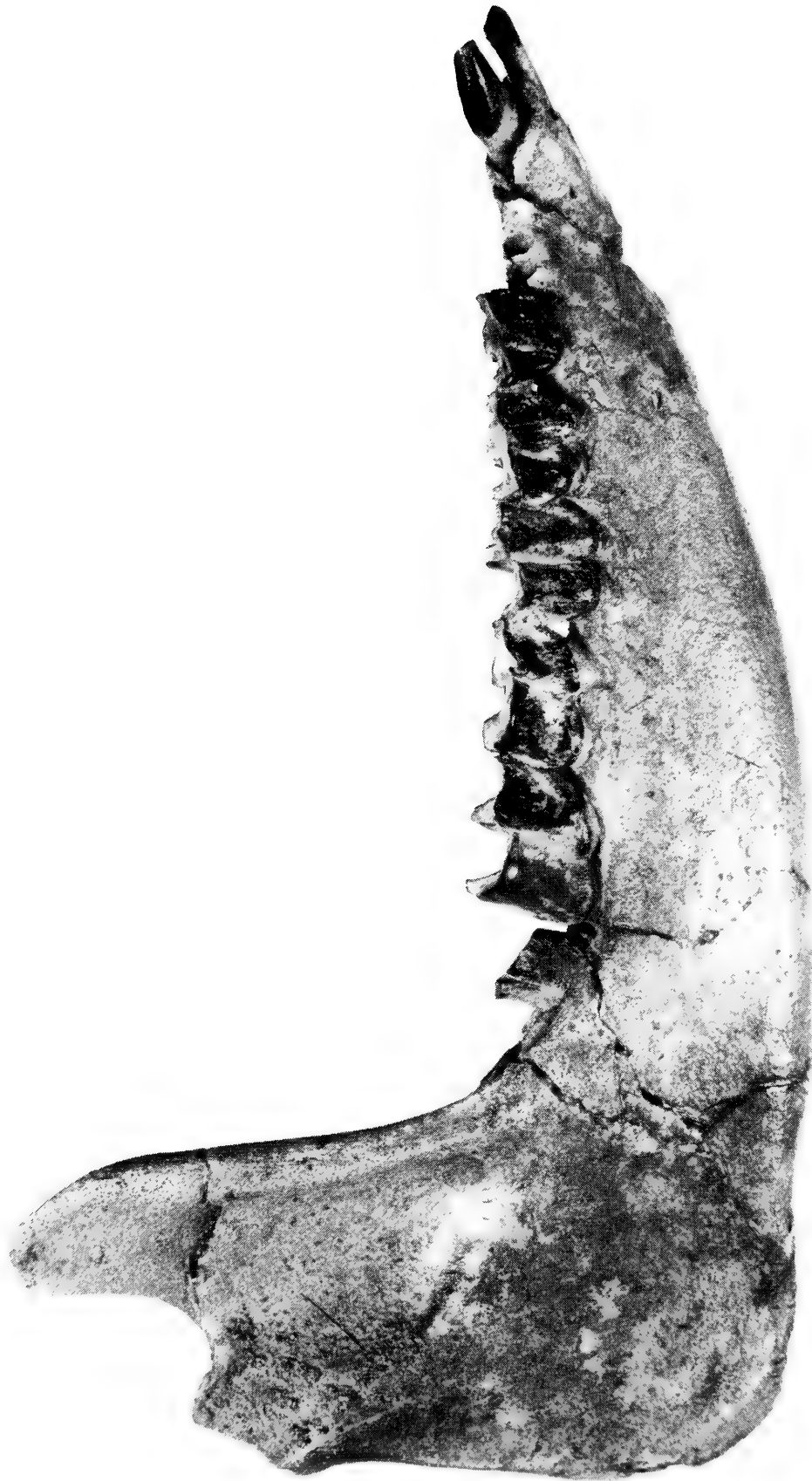


Fig. 20 *Trigonias*, species C, SMNH P1635.1, incomplete mandible showing I₁, I₂, and P₂ to M₃; right lateral view, × 0.75.



Fig. 21 *Trigonias*, species C, SMNH P1635.1, showing left I₂ and P₁ to incomplete M₃, and right I₁, I₂, and P₂ to M₃; occlusal view, × 0.75.

DESCRIPTION

The teeth of the SMNH mandible are moderately worn, especially I₁, I₂, and M₁. On the ROM specimen only M₁ shows appreciable wear. The latter mandible has the alveolar margin evenly rounded in front, reminiscent of *Hyracodon*, and the symphysis forming a shallow trough as far back as the midlength of P₂. Turning to the SMNH jaw, its I₁ has a very long root, and a short, somewhat trenchant crown. It lies close to the midline of the jaw and to I₂. The latter tooth is much larger and is tusk-like and prominent. I₃ is not preserved on either specimen, but the alveolus is crowded against that of I₂. There is no trace of the canine, either as tooth or alveolus. The diastema between I₃ and P₁ is short on SMNH P1635.1, somewhat longer on ROM 11629.

P₁ is a small tooth, ovoid in outline, slightly flattened posteriorly. The crown has a long medial ridge, with a single cusp (= protoconid) at about midlength of tooth. Behind this the ridge is worn. P₂ has a submolariform trigonid and a molariform talonid; the crown tapers slightly anterad. P₃ is almost molariform, the characteristic LL pattern of the crests being well defined; as with P₂ the crown tapers somewhat anterad. P₄ is a little larger than P₃ and does not taper anterad; the protolophid is the highest part of the tooth and forms a transverse wall from protoconid to metaconid.

The first lower molar is similar to P₄ but a little larger. The L-shaped trigonid forms a sharp angle at the protoconid, between protolophid and metalophid, but the crest of the talonid is more rounded, and the position of the hypoconid is vague, whereas the entoconid is distinct, and almost as high as the metaconid. M₂ is almost identical with M₁, but is less worn. M₃ is mostly below the alveolar rim on ROM 11629, and barely above the rim on SMNH P1635.1.

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
SMNH P1635.1		
Right tooth row, from I ₁ to M ₃	170.7	—
Right I ₁ , crown	6.6	4.6
Right I ₂ , crown	9.8	8.0
Left P ₁	8.8	5.3
Right P ₂	15.5	9.9
Right P ₃	17.2	11.8
Right P ₄	18.1	13.5
Right M ₁	23.2	15.1
Right M ₂	25.9	16.3
Right M ₃	—	13.2

REMARKS

The dentition of these two lower jaws closely resembles that of *Trigonias osborni* as described and illustrated by Wood (1928); in particular, the large, procumbent I₂ and the small but distinct P₁ are similar. Gregory and Cook (1928:6) postulated that in *Trigonias* the I₃ was lost before the lower canine, but these specimens show the



Fig. 22 *Trigonias*, species C, ROM 11629, incomplete mandible, showing left P₁ to P₄ and right P₁ to M₃; occlusal view, × 0.75.

alveolus for I₃ but no trace of the canine. In size the present specimens are only about two-thirds that of the corresponding parts in *T. osborni*. They probably represent an undescribed species, but in the absence of associated upper dentition they are not considered adequate for a specific definition.

Trigonias species D

REFERRED SPECIMENS

SMNH P1119.1, portion of right mandibular ramus with part of symphysis, left I₁ and P₁, right I₁, P₁, P₂, incomplete P₃ and P₄; Calf Creek. ROM 5921 (Fig. 23), incomplete right mandibular ramus with P₃ to M₃; Hunter Quarry. ROM 23184 (Fig. 24), fragmentary right mandibular ramus with P₃, DP₄, P₄, M₁ and M₂; Hunter Quarry. ROM 23186 (Figs. 25, 26), left mandibular ramus and part of symphysis, with P₂ to M₃; Hunter Quarry. ROM 23187, fragment of right mandibular ramus with M₃ and incomplete M₁ and M₂; Hunter Quarry. ROM 23188, left mandibular ramus with P₃ to M₃; Hunter Quarry. ROM 23189, fragment of left mandibular ramus with M₁ to M₃; Hunter Quarry. ROM 23196, left mandibular ramus with P₃ to M₃; Hunter Quarry.

DESCRIPTION

The mandibular rami listed above appear to represent a single species and will be described together. ROM 23186 is the best preserved and will serve as the basis of the description. The remnant of the symphysis retains part of the alveoli of both I₁ and left I₂, but no trace of I₃ or C; the I₂ was a large, procumbent tusk. P₁ is represented by the alveolus, the anterior pit being distinct, the posterior closely appressed against P₂. The latter tooth is ovoid, tapering anterad; the crown is worn but shows a large central cusp on an anterior crest, with a short oblique crest running posterolingual from the cusp. P₃ is molariform except that the trigonid is narrower than the talonid. P₄ is quite molariform but has the small entoconid distinctly separated from the lingual end of the hypolophid. The molars have the talonid about as high as the trigonid. The trigonid crest is L-shaped, that of the talonid is crescentic. The condyle and the coronoid process are almost intact. There is a large dental foramen below the coronoid process. Two mental foramina are present anteroventral to P₂.

ROM 23188 closely resembles 23186, but is more damaged anteriorly and in the condylar/coronoid region. The P₃ is preceded by two alveolar pits, which indicate the former presence of P₂ but not P₁. The remaining teeth are almost identical in size with those of ROM 23186, but the P₃ to M₁ are deeply worn.

ROM 23196 is also closely comparable with 23186, but is slightly smaller. All of the preserved teeth, P₃ to M₃, are deeply worn. There are well-preserved alveoli for P₁ and P₂.

ROM 5921 is also slightly smaller than ROM 23186. The entoconid on P₄ of 5921 is incompletely separated from the hypolophid. ROM 23184, although fragmentary, is interesting in that DP₄ is present with the unerupted P₄ below it in the jaw. The DP₄ is completely molariform but of course deeply worn. The P₄ has the entoconid



Fig. 23 *Trigonias*, species D, ROM 5921, incomplete right mandibular ramus with P₃ to M₃; occlusal view, × 0.75.



Fig. 24 *Trigonias*, species D, ROM 23184, fragmentary right mandibular ramus with P₃, DP₄, P₄, M₁, M₂; lingual view, × 1.



Fig. 25 *Trigonias*, species D, ROM 23186, left mandibular ramus and part of symphysis, with P₂ to M₃; lateral view, × 0.5.



Fig. 26 *Trigonias*, species D, ROM 23186; occlusal view, $\times 0.75$.

incorporated into the hypolophid, in contrast to that tooth in ROM 23186. ROM 23187 and 23189, which retain only the molars, are not especially noteworthy. They agree closely in size with ROM 23186.

SMNH P1119.1 is of interest because it shows the I₁ and the P₁. The incisor is small and spatulate, and originally was partly overlaid by the procumbent I₂. There was evidently a small I₃. The P₁ is a small ovoid tooth, slightly trenchant, with a prominent cusp at midlength and small cuspules in front and behind. This specimen is smaller and more delicate than ROM 23186, but the comparable teeth are about the same in size.

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
ROM 23186		
Left P ₂	17.2	12.0
Left P ₃	20.8	16.4
Left P ₄	22.1	18.6
Left M ₁	27.7	19.6
Left M ₂	32.2	22.0
Left M ₃	34.8	21.2

REMARKS

Assuming that all of these mandibular rami represent a single species, this would appear to be close to *Trigonias osborni* but consistently somewhat smaller. At the same time they are distinctly larger than SMNH 1635.1 and ROM 11629 (species C). The reference to *Trigonias* is based on the presence of nearly all specimens of P₁. The exception is ROM 23188, on which P₁ evidently was absent. However, that specimen is otherwise so similar to ROM 23186 that it is included in this group tentatively as an individual variant.

Trigonias? spp.

REFERRED SPECIMENS

ROM 5932 (Fig. 27), fragment of left maxilla with P² and P³, almost unworn. ROM 23183 (Fig. 28), incomplete mandible with left and right P₂ to M₃. Both from Hunter Quarry.

DESCRIPTION

The crown pattern of the two teeth on ROM 5932 suggests deciduous premolars, but the absence of wear makes this unlikely. P² has distinct protoloph and metaloph, not quite connected to the ectoloph. There is a small but high conical hypostyle well clear of the metaloph. P³ is decidedly molariform except for the strong lingual cingulum and oblique lingual margin. The size is much smaller than that given by Wood (1928) for *T. osborni* but is similar to that of SMNH P833.1.



Fig. 27 *Trigonias?* sp., ROM 5932, fragment of left maxilla with P² and P³; occlusal view, × 1.

ROM 23183 is the smallest mandibular specimen in the collection other than those referred to *Hyracodon*. It may belong to *Trigonias* because of the crown pattern of M₃, with the protolophid forming a continuous curve from protoconid to parastylid. The most interesting feature is the pattern produced on P₂, P₃, and M₁ by the deep wear (Fig. 28).

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
ROM 5932		
Left P ³	18.1	21.0
Left P ⁴	19.8	25.1
ROM 23183		
Left P ₂ to M ₃	107.3	—
Left P ₂	12.3	11.1
Left P ₃	16.0	13.9
Left P ₄	16.7	14.9
Left M ₁	20.5	17.1
Left M ₂	24.2	17.4
Left M ₃	26.9	15.7

Subhyracodon Brandt, 1878

GENERIC CHARACTERS

Medium-sized rhinoceroses. Dentition $\frac{3-2 \ 1-0 \ 4 \ 3}{2 \ 0 \ 4 \ 3}$. I¹ blade-like, moderately elongate. I² small, conoid. Upper C small and vestigial to absent. P¹ submolariform. P² molariform but with transverse lophs tending to unite lingually. P³ molariform, lophs quite separate. P⁴ less molariform, with reduced metaloph. Strong lingual cingulum on upper premolars. M¹ and possibly M² with antecrochet. Distinct but interrupted lingual cingulum on upper molars. I₁ vestigial. I₂ elongate, compressed, more or less procumbent. P₁ compressed conoid, single-rooted; P₂ and P₃ submolariform; P₄ molariform. Skull almost flat dorsally from nasals to occiput, there being no dorsad curvature posteriorly. Nasals narrow and pointed, extending

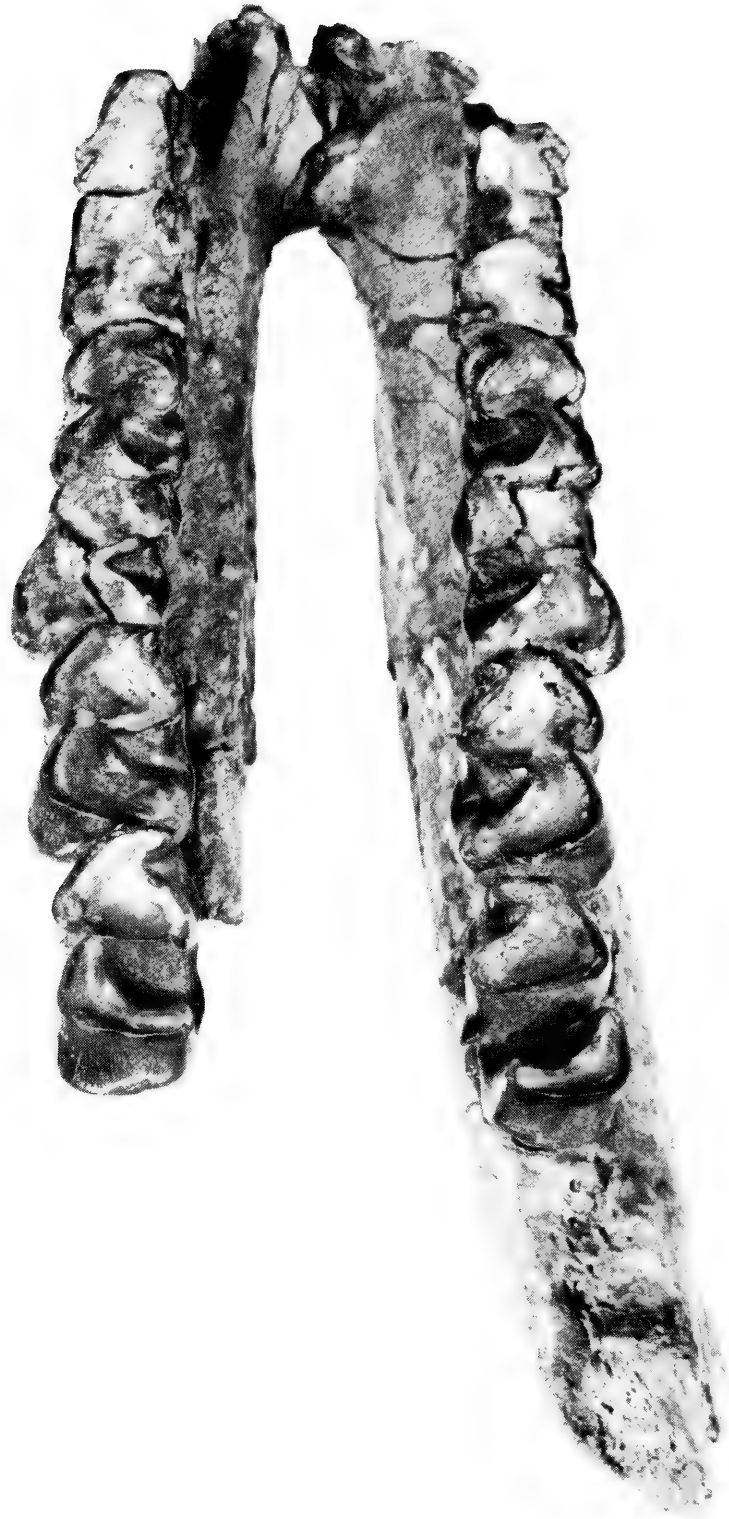


Fig. 28 *Trigonias?* sp., ROM 23183, incomplete mandible with left and right P₂ to M₃; occlusal view, × 1.

about as far anterad as the premaxillae. Sagittal crest low, incipiently double, diverging anterad towards orbits and posterad into the lambdodal crest. Manus tridactyl.

TYPE

Rhinoceros occidentalis Leidy, 1851

Subhyracodon sagittatus, sp. nov.

ETYMOLOGY

Sagittatus, Latin, arrow-shaped, in reference to the distinct sagittal crest.

TYPES

Holotype: SMNH P1635.2 (Figs. 29–31), nearly complete skull with right I³ to M³ and left P¹ to M³. Paratype: SMNH P833.1 (Figs. 32–34), immature skull with both P¹, DP² to DP⁴, M¹, partly erupted M². Both from Hunter Quarry.

SPECIFIC CHARACTERS

Smaller than *Subhyracodon trigonodus* (Osborn and Wortman, 1894) and *S. copei* (Osborn, 1898), and much smaller than *S. occidentalis* (Leidy, 1851). Skull relatively broad; sagittal crest low but distinct, relatively long. Upper dentition with three incisors, the first not specially enlarged. Upper canine absent; very short diastema between I³ and P¹. P⁴ with reduced metaloph.

DESCRIPTION

The holotype skull lacks most of the basicranium, the right zygoma, and the left premaxilla. The skull roof, including the nasals and supraoccipitals, the facial, orbital, and palatal regions are well preserved.

The incomplete right premaxilla has two alveoli, of about equal size, followed by a slender, peglike, pointed tooth. As this tooth is immediately in front of the premaxilla-maxilla suture, it is identified as I³. The moderate size of the first alveolus indicates that I¹ was not specially enlarged. Behind the suture there is a very short interval of edentulous maxilla, with no trace of, and hardly space for, a canine. P¹ is badly worn on both sides; it is ovoid in outline, with a hook-shaped prolongation anterolingually. P², although well worn, preserves the molariform pattern with well-developed protoloph and metaloph, but there is a posterad-directed spur from the protocone that connects with the metaloph; the lingual cingulum is continuous and the lingual margin symmetrically rounded. P³ is more molariform, the protoloph and metaloph being well developed and distinct, the former slightly wider than the latter; the lingual cingulum is continuous, and the lingual margin almost symmetrically rounded. P⁴ is less molariform, the protoloph being wide and high, but the metaloph



Fig. 29 *Subhyracodon sagittatus* Russell, sp., nov. SMNH P1635.2, holotype, nearly complete skull; dorsal view, $\times 0.75$.



Fig. 30 *Subhyracodon sagittatus* Russell, sp. nov., SMNH P1635.2, holotype, showing right I³, P¹ to M³;
right lateral view, × 0.75.

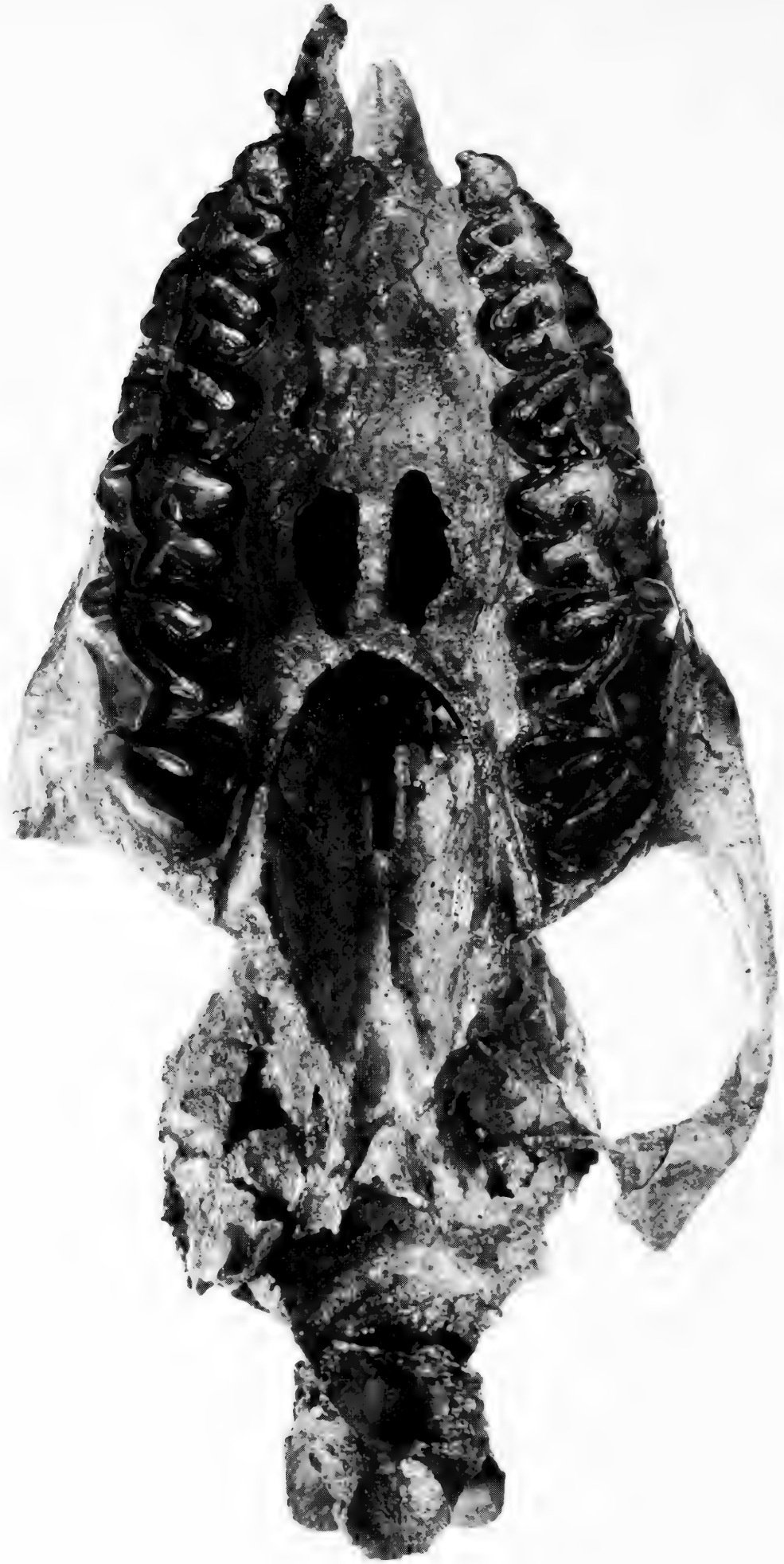


Fig. 31 *Subhyracodon sagittatus* Russell, sp. nov., SMNH P1635.2, holotype, showing left P¹ to M³ and right I³, P¹ to M³; occlusal view, × 0.75.

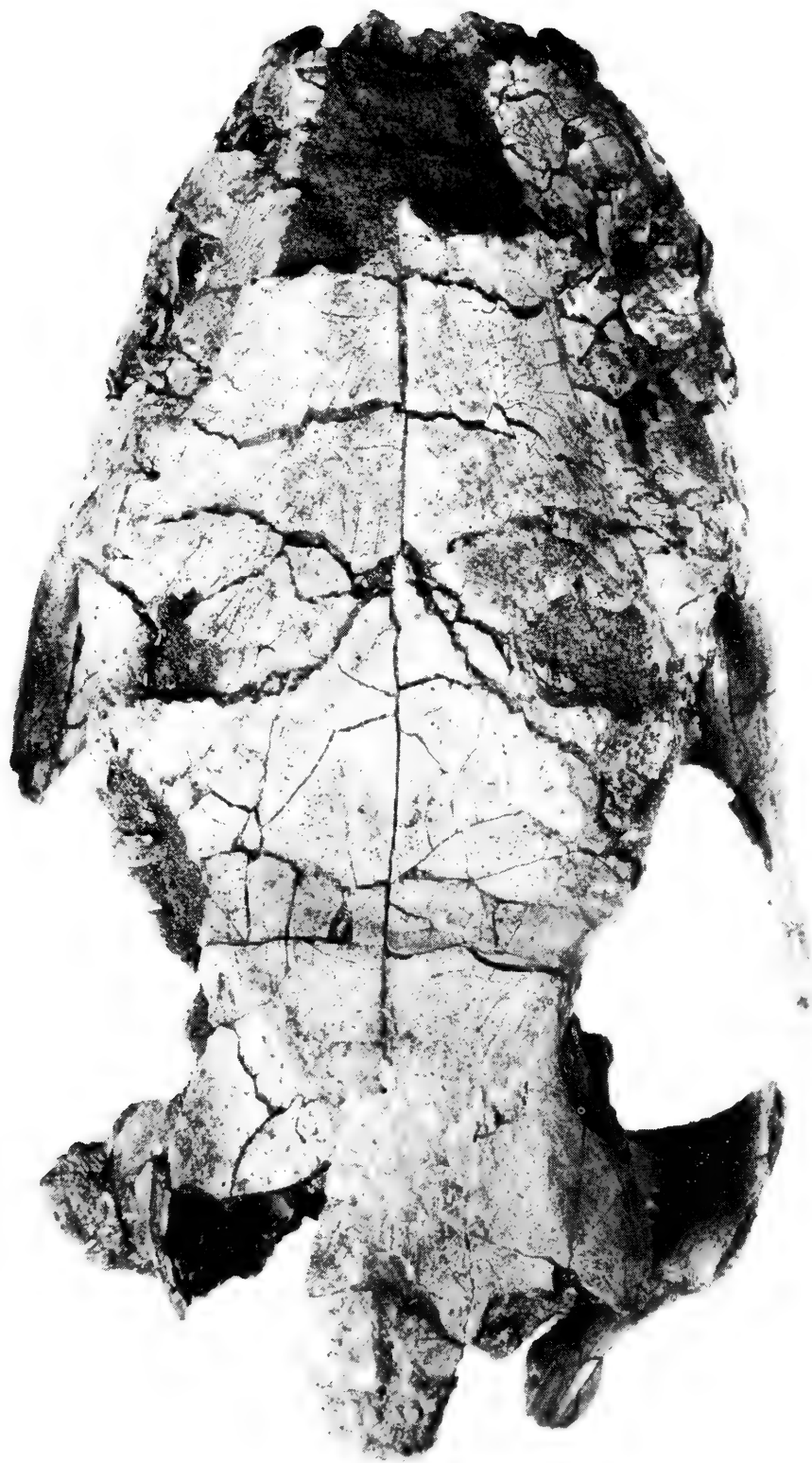


Fig. 32 *Subhyracodon sagittatus* Russell, sp. nov., SMNH P833.1, paratype, immature skull; dorsal view, $\times 0.75$.



Fig. 33 *Subhyracodon sagittatus* Russell, sp. nov., SMNH P833.1, paratype, showing right P¹, DP² to DP⁴, M¹, M²; right lateral view, × 0.75.

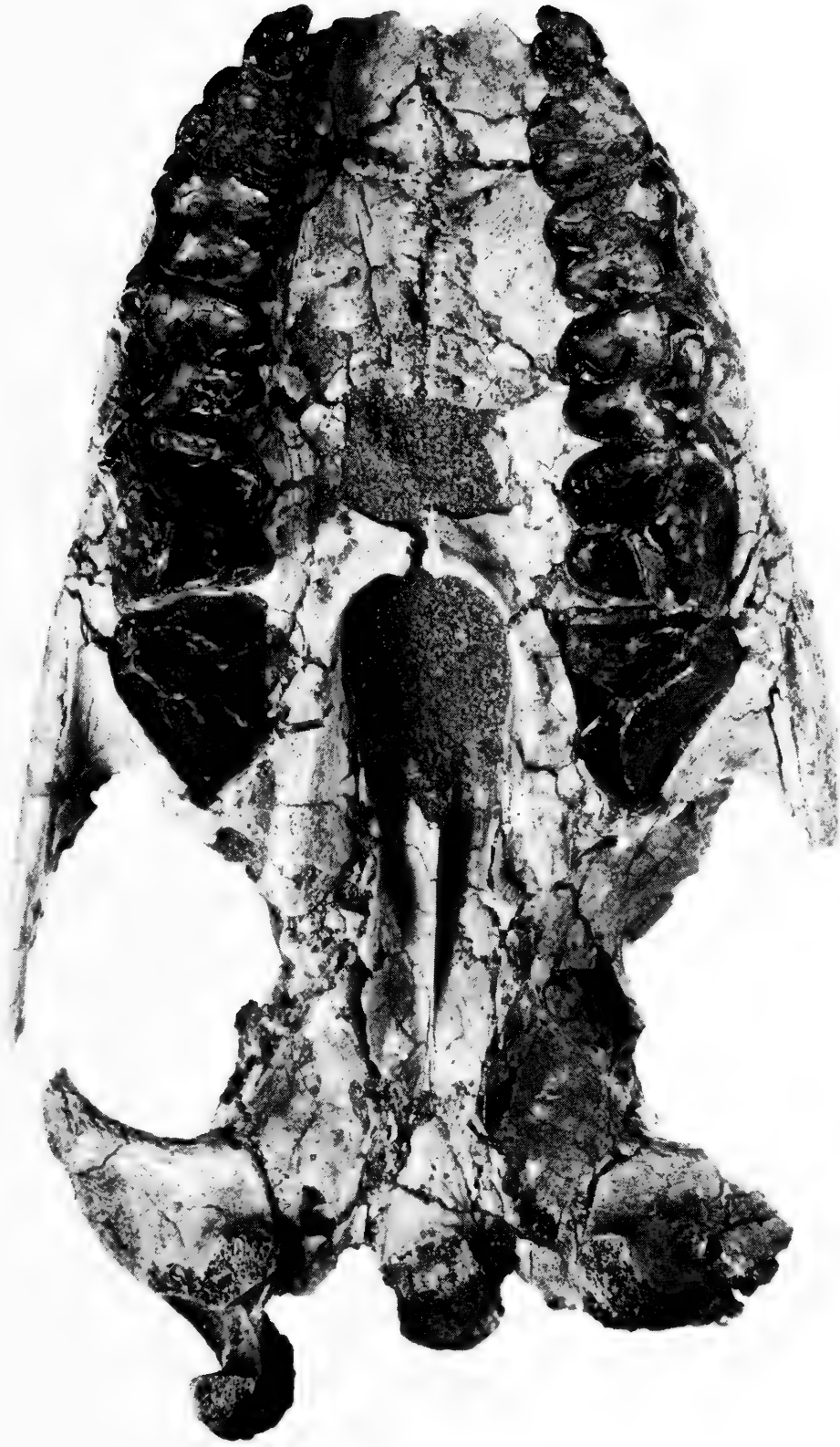


Fig. 34 *Subhyracodon sagittatus* Russell, sp. nov., SMNH P833.1, paratype, showing both P¹, DP² to DP⁴, M¹, M²; occlusal view, × 0.75.

is much shorter and lower, failing to reach the crown margin but converging slightly on the protocone; the lingual cingulum is strongly developed and the lingual margin is oblique, curving posterobuccad from the protocone base. M^1 is well worn; there is a large, rounded antechrochet on the protoloph. M^3 has a very short ectoloph and a reduced metacone; the protoloph and metaloph are slightly divergent linguad.

The skull is proportionately broader than that of *S. occidentalis* as illustrated by Scott (1941:84, fig. 1a). The most conspicuous difference is in the *sagittal crest*, which is single, and distinct for most of the cranial length, although showing a trace of a double origin, which becomes obvious anteriorly, where the two components spread apart. In lateral view the dorsal outline of the skull rises somewhat anterior to the occiput, then slopes off as the sagittal crest diverges into the lambdoidal crest. The *frontals* form an almost flat platform between the orbits, with large but blunt postorbital processes. Like the frontals, the *nasals* are relatively broad. The free anteroventral margin, forming the dorsolateral rim of the naris, has a distinct notch on each side, as in *Hyracodon*.

The *premaxillae* are short, and the suture with the maxillae is almost vertical, meeting the narial margin just as it begins to curve dorsad; there is thus a wide separation from the nasals. The *maxillae* form the lower part of the lateral facial wall and have the infraorbital foramen above the contact of P^3 and P^4 . The suture with the nasals is almost horizontal, except for a dorsad angulation just in front of the lachrymals. The maxillary margin then turns ventrad along the front of the lachrymals and the jugals, and posterad beneath the jugals to the temporal opening. Ventrally the maxillae form the anterior portion of the palate to the juncture of M^1 and M^2 , then extend posterad along the alveolar rim in suture with the palatines to the temporal opening. The *jugals* meet the squamosals on the zygomatic arch by a very oblique suture, which does not quite reach the glenoid cavity. There is only a rudiment of a postorbital process on the dorsal rim of the jugals. The *squamosals*, as preserved, are much as described by Scott, except that they form all of the glenoid cavity. Within the temporal fossa there is a large foramen in front of the alisphenoid-squamosal suture, presumably housing the foramen opticum and the alisphenoid canal.

As noted, the basicranium is poorly preserved, and the sutures that define *vomer*, *palatines*, and *pterygoids* are obscure. The bifurcated posterior end of the vomer is separated from the presphenoid by a curved groove. The posterior opening of the alisphenoid canal is conspicuous on the side of the alisphenoids.

The paratype (SMNH P833.1) is about the same size as the holotype, but is obviously juvenile, not only on the basis of the dentition, but also because many of the sutures are not firmly closed. The first premolars are not as worn as is the tooth that follows, hence the identification as P^1 rather than DP^1 ; they are similar to the P^1 of the holotype, with a main buccal cusp (worn), a metaloph-like crest extending from the main cusp, and an isolated cusp on the lingual margin, anterior to the crest; the anterior extremity of this tooth is a spurlike projection directed anterolinguad.

The next three teeth are obviously deciduous, as indicated by the extreme degree of wear and the very molariform crowns. DP^2 is somewhat narrower anteriorly than posteriorly. Little of the original crown structure remains, but the protoloph and metaloph were evidently well developed and distinct. DP^3 is not quite so badly worn, and retains remnants of the re-entrants between the lingual ends of protoloph and metaloph and between metacone and hypocone. DP^4 is worn, but has the molariform

pattern so well developed that an isolated example could be mistaken for M¹. The ectoloph is sinuous, as in the molars, and the paracone is prominent. The protoloph is more worn than the metaloph, but still shows a rounded antecrochet. The metastylar extension of the ectoloph is more obvious than on DP³, and laps slightly on the protoloph of M¹. If this were P⁴, the lap would be the other way around.

M¹ is typically rhinocerotid; the protoloph is less worn than the metaloph, and there is no antecrochet. M² is incompletely erupted, and in this position looks like M³, but the posterior extension of the ectoloph (metastyle) is long, and curves posterolingual, then posterad. The metaloph is short, and is directed posterolingual, with a slight angulation at the point of origin on the metacone.

The skull has most of the roof and face preserved, and the bones are still in place although badly shattered. The parietal area of the cranial roof is incomplete, but evidently bulged a little more prominently dorsad than it does in the holotype. The anterior end of the sagittal crest is indicated by the remnant of its base, but evidently it was distinct and somewhat elevated. The premaxillae are missing but clearly were separated from the nasals by a long portion of the narial rim formed by the maxillae. The glenoid fossa is well preserved on the right side; it is shallow but with a prominent postglenoid process at the posterolingual corner of the fossa.

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
SMNH P1635.2		
Skull, from tip of nasals to lambdoidal crest	277.0	—
Skull, from widest point of zygomata (estimated)	—	137.5
Skull, facial portion of maxillae (estimated)	—	97.5
Left P ¹ to M ³	124.9	
Left P ¹ to M ¹	82.8	
Left P ¹	13.0	
Left P ²	16.1	19.4
Left P ³	17.7	22.2
Left P ⁴	19.2	23.7
Left M ¹	24.9	25.1
Left M ²	26.9	27.7
Left M ³	23.3	24.5
SMNH P833.1		
Skull, from widest point of zygomata (estimated)	—	135.4
Skull, facial portion of maxilla (estimated)	—	101.4
Left P ¹ to M ¹	93.9	—
Left P ¹	13.7	—
Left DP ²	16.6	18.3
Left DP ³	20.3	20.5
Left DP ⁴	21.8	22.6
Left M ¹	28.0	25.0
Left M ²	29.6	±26.1

REMARKS

This species, as known from the two skulls described above, presents a combination of features that make difficult a definite assignment to a known rhinocerotid genus. The reference to *Subhyracodon* is based on the low, almost flat, skull roof as seen in lateral profile, the low but distinct sagittal crest, the relatively long facial region, the exclusion of the premaxillae from contact with the nasals, and the molariform pattern of P² to P⁴. There are some resemblances to *Hydracodon*, such as the presence of three simple incisors, but the absence of a post-incisor diastema is a striking difference. The characters that are taken to justify the status of a distinct species of *Subhyracodon* have been mentioned; these include the absence of an incisor-premolar diastema and the free termination of the protoloph and metaloph in P² to P⁴. It is possible that we are dealing here with an unrecorded genus.

Caenopus Cope, 1880

GENERIC CHARACTERS

Rhinocerotids of moderate size. Dentition $\frac{2}{2-1} \frac{1-0}{0} \frac{4}{3} \frac{3}{3}$; I² and I₁ not enlarged; P² and P⁴ molariform, P³ submolariform. Mandibular symphysis narrow. Manus tridactyl.

Caenopus? spp.

REFERRED SPECIMENS

ROM 23190 (Fig. 35), portion of right mandibular ramus with P₃ to M₃ and posterior root of P₂. ROM 23191 (Fig. 36), incomplete left mandibular ramus with P₃ to M₃. ROM 23192 (Fig. 37), incomplete left mandibular ramus with P₃ to M₃. ROM 23193 (Fig. 38), fragmentary right mandibular ramus with P₃ to M₃. ROM 23194 (Fig. 39), portion of left mandibular ramus with roots of P₂ (?), entire DP₃ and DP₄, worn M₁, and unworn but broken M₂. All from the Hunter Quarry.

DESCRIPTION

ROM 23190 is of about the same size as *Caenopus mitis* as recorded by Wood (1928). The root and alveoli of P₂ suggests a tooth much smaller than P₃, and probably the first of the cheek series. This, and the narrow trigonid of P₃, suggest that there was no P₁. The P₄ is worn, but less so than the M₁, which overhangs the posterior rim of P₄.

On ROM 23191 the M₃ is fully formed but not yet fully erupted. It has an unworn trigonid distinctly higher than the talonid. M₁ is the only well-worn tooth. This specimen agrees in size and structure with ROM 23190. ROM 23192 has the P₄ worn but not quite fully erupted. In other respects the teeth resemble those of ROM 23190. ROM 23192 is a little smaller than 23190, but the teeth are almost identical in structure.



Fig. 35 *Caenopus?* sp., ROM 23190, portion of right mandibular ramus with P₃ to M₃; occlusal view, × 1.



Fig. 36 *Caenopus?* sp., ROM 23191, incomplete left mandibular ramus with P₃ to M₃; occlusal view, × 1.



Fig. 37 *Caenopus?* sp., ROM 23192, incomplete left mandibular ramus with P₃ to M₃; occlusal view, × 1.



Fig. 38 *Caenopus?* sp., ROM 23193, incomplete right mandibular ramus with P₃ to M₃; occlusal view, × 1.

ROM 23194 is larger than the incomplete rami described above and probably represents a different species. The most anterior tooth, represented by two closely appressed roots, is evidently the first of the cheek series, as there is no trace of alveoli in front. It is followed by a much larger tooth, with narrow, trenchant crown, now well worn; there is a main cusp and a principal crest extending in front and behind. From the cusp there is a short, oblique crest, like a protolophid, and at the posterior end there is a short hypolophid. This tooth is interpreted as DP₃. The supposed DP₄ is a very long, narrow tooth, tapering anterad; it has a molariform protolophid and hypolophid, but from the protoconid a crest runs anterad, with a transverse crest extending linguad to the paraconid. The effect is that of a tooth with two talonids. M₁ is a more conventional tooth, but the protolophid and metalophid are nearly straight, forming a sharp V. M₂ also shows this V-shaped trigonid, but the protolophid is recurved at the parastylid. The apparent absence of P₁ is the principal basis for the reference of this specimen to *Caenopus*. The deciduous premolars of *Caenopus* have not been described, but those of the present specimen are very different from those here referred to *Trigonias* (e.g., ROM 23184).

MEASUREMENTS (in millimetres)

	<i>Length</i>	<i>Width</i>
ROM 23190		
Right P ₃	18.8	13.8
Right P ₄	19.2	15.0
Right M ₁	20.7	15.3
Right M ₂	27.1	16.6
Right M ₃	28.5	14.9
ROM 23194		
Left DP ₃	18.4	10.4
Left DP ₄	28.7	15.1
Left M ₁	28.6	17.4
Left M ₂	—	16.5

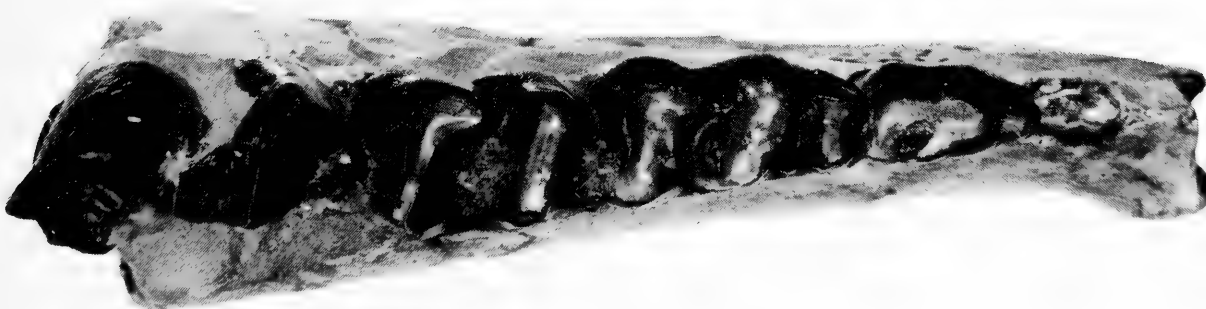


Fig. 39 *Caenopus?* sp., ROM 23194, incomplete left mandibular ramus with DP₃, DP₄, M₁, M₂; occlusal view, × 1.

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I should like to dedicate this Contribution to the memory of Dr. Horace Elmer Wood, II, for many years the leading authority on Tertiary Rhinoceroidea.

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