A NEW CERATOPSIAN DINOSAUR FROM THE UPPER CRETACEOUS OF MONTANA, WITH NOTE ON HYPACROSAURUS[1]

By CHARLES W. GILMORE

ASSISTANT CURATOR OF FOSSIL REPTILES, U. S. NATIONAL MUSEUM.

(With Two Plates)

INTRODUCTION

The fossil remains upon which the present communication is based were collected by the writer during the summer of 1913 while working under the auspices of the U. S. Geological Survey on the Blackfeet Indian Reservation in northwestern Montana. The partial skeletons of five individuals were found and these supplement one another to such an extent that nearly all parts of the skeleton are represented. The skull presents some anatomical features not heretofore known in the Ceratopsia and the new genus and species *Brachyceratops montanensis* is here proposed.

This new form is the smallest known representative among the Ceratopsian dinosaurs and in several respects strikingly different from any of its allied contemporaries.

The present paper is preliminary. Upon the completion of the preparatory work now in progress a more detailed account of the skeletal anatomy and a discussion of its affinities will be given.

BRACHYCERATOPS MONTANENSIS, new genus and species

Type.—Cat. No. 7951 U. S. Nat. Mus. A considerable portion of a disarticulated skull (*i. e.*, nasals, prefrontals, postfrontals, postorbitals, premaxillaries, maxillaries, alisphenoid), with which is provisionally associated a fragmentary part of the frill and a right dentary and a predentary.

Type locality.—N. E. ¼ Sec. 16, T 37 N, R 8 W, Milk River, Blackfeet Indian Reservation, Teton County, Montana.

Paratypes.—Cat. No. 7952, U. S. Nat. Mus. Rostral and portions of the premaxillaries; Cat. No. 7953 U. S. Nat. Mus. Sacrum,

[1] Published by permission of the Director of the U. S. Geological Survey.

complete pelvis and articulated caudal series of 45 vertebræ continuing to the tip of the tail; Cat. No. 7957, U. S. Nat. Mus. Two tarsals of the distal row, four articulated metatarsals, a portion of the fifth, and eleven phalanges.

Localities.—Same as the type.

Horizon.—From the upper part of an Upper Cretaceous formation soon to be described by the U. S. Geological Survey, which includes the equivalent of the Judith River formation and some older beds. The fossiliferous horizon is also the equivalent of the upper part of the Belly River formation, as described in neighboring areas of Canada.

Generic and specific characters.—Typically of small size. Skull with facial portion much abbreviated, and deep vertically. Supraorbital horn cores small. Nasal horn core outgrowth from nasals, large, slightly recurved, laterally compressed, and divided longitudinally by median suture. Frill with comparatively sharp median crest, fenestræ apparently of small size, and entirely within the median element. Supratemporal fossæ opening widely behind. Border of frill scalloped, but without separate marginal ossifications. Dentition as compared with *Triceratops* greatly reduced.

Description of skull.—The description to follow is devoted entirely to a consideration of the skull, since it shows characters of sufficient importance to readily distinguish it from all the other known members of the Ceratopsian group, which in the greater number of instances have also been established upon cranial material.

When found, the skull was entirely disarticulated, but the excellent state of preservation of the bone and the absence of distortion by crushing rendered the assembling of the scattered elements a comparatively easy matter. This specimen is of the utmost importance in the evidence it gives for the proper interpretation of the cranial elements, and especially the positive information it affords relating to those parts of the Ceratopsian cranium now somewhat in controversy.

In the above diagnosis of the genus and species, it is stated to be typically of small size. While this statement is true so far as applied to the known specimens, it should also be stated that to some extent the small size of these specimens may be due to the immaturity of the individuals. The open sutures of the skull, sacrum, and vertebræ all testify to the youth of the animals.

Viewing the skull in profile (pl. 1), one is especially impressed by the great abbreviation of the facial portion, when compared with the

Ceratopsians of the Lance formation. It is to this shortening that the generic name refers. The narial opening, as in other known Judith River and Belly River forms, is situated well forward and under the nasal horn, whereas in the later and more highly specialized *Triceratops* this orifice is entirely posterior to that horn. The distance between the nasal and supraorbital horns, as seen in the upper outline, is exceedingly short, due largely to the shortened nasal bones and the great fore and aft development of the basal portion of the nasal horn and also to the forward position over the orbits of the small brow horns.

The exact pitch of the frill portion in relation to the anterior part of the skull cannot be positively determined, though in the drawing it has been placed in accordance with the evidence of articulated skulls.

This specimen brings to light an entirely new phase of nasal horn development and one which, so far as our previous knowledge goes, appears to be unique among dinosaurs. Reference is made here to the longitudinal separation of the horn core into two halves by the nasal suture. This also indicates the nasal horn to be an outgrowth from the nasal bones instead of having originated from a separate center of ossification, as is the case in the more specialized *Triceratops*. It appears quite probable there are some of the described Belly River species that will also show a similar mode of nasal horn development when juvenile specimens are found.

The nasals are especially deep and massive, due to the development on their superior surfaces of the nasal horn cores. Posteriorly they present a pointed process with a beveled underlapping surface for contact with the prefrontals (the frontals and lachrymals of authors). Laterally they send down a deep extension to meet the premaxillary, and anteriorly the arched ventral borders of the nasal bones form the upper half of the boundary of the narial orifice. Anteriorly they send out vertically flattened processes (see *p*, fig. 1) between which are received the ascending processes of the premaxillæ. This nasal process appears to end about 32 mm. in advance of the forward line of the horn core, so that the upper outline of the beak is formed largely by the premaxillaries. The horn has a broad fore and aft extent at its base, but tapers rapidly to a bluntly pointed horn of moderate height. Transversely it is much compressed at the base, though inclined to expand somewhat toward the summit. The horn as a whole is directed somewhat forward, but the curve of the posterior side is such as to give the impression

that its upper part is slightly recurved. The surfaces of the upper half are roughened and grooved by vascular impressions.

On the tip of the left half of the nasal horn is a small, flattened oval bony ossicle, which rests in a shallow depression or pit on the apex of the horn as shown at *os*, figure 1. This ossicle is a distinct element from the underlying bone and may represent the incipient horn of later Ceratopsians where it is known to be developed from a center of ossification distinct from the nasal bones.

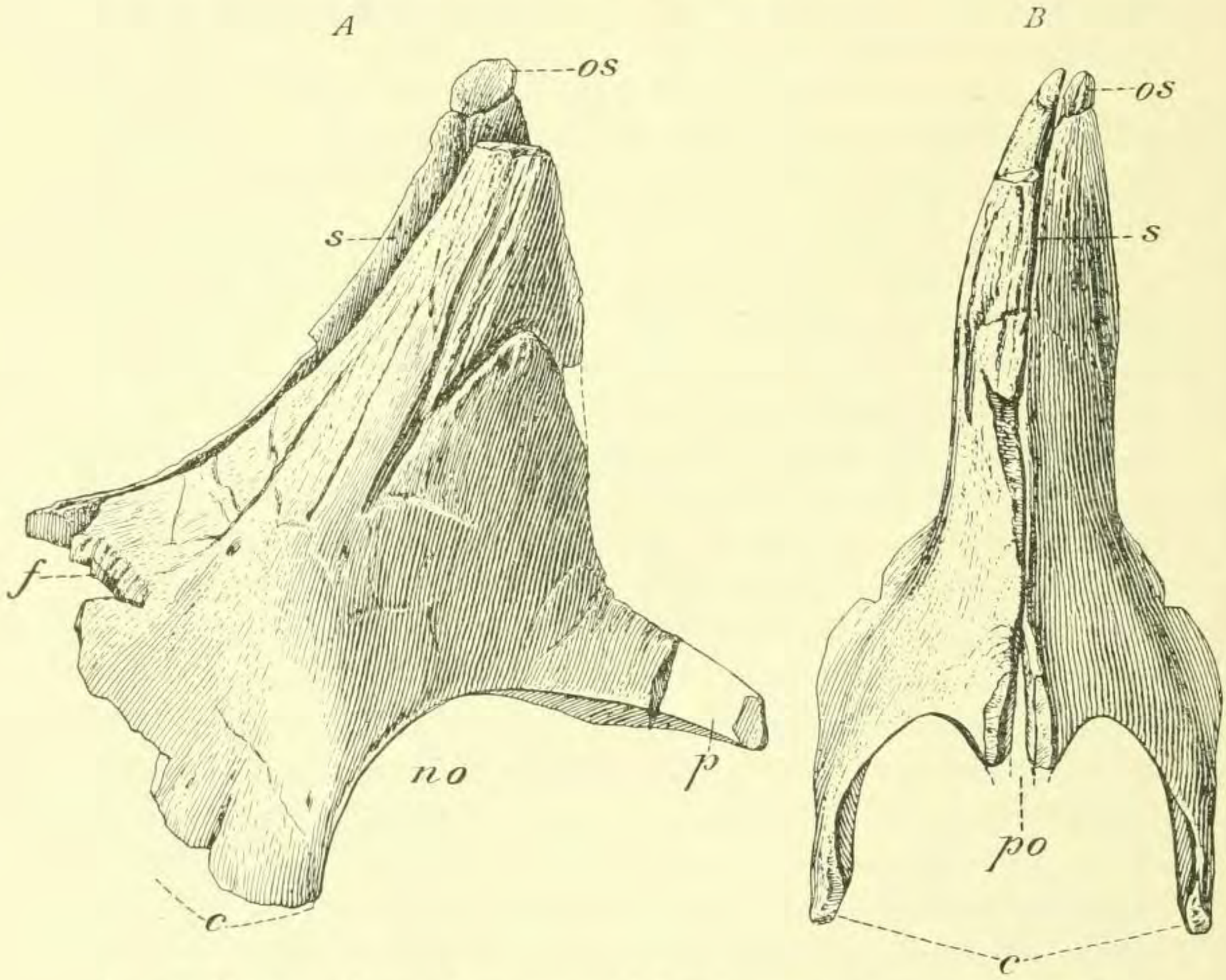


FIG. 1.—Nasals and nasal horn cores of *Brachyceratops montanensis*. Type: Cat. No. 7951 U. S. Nat. Mus., ½ Nat. size. A, side view; B, front view; *c*, surface for contact with the premaxillaries; *f*, surface for articulation of prefrontal; *no*, anterior nasal opening; *os*, ossicle on top of horn core; *p*, anterior process of nasal; *po*, orifice for superior processes of premaxillaries; *s*, suture separating two halves of nasal horn.

The maxillaries are of triangular outline with alveoli for twenty teeth in the functional row. As compared with *Triceratops* this is a greatly reduced number, *Triceratops* having forty alveoli in the maxillary. In this specimen all of the functional teeth have fallen out, but two or more germ teeth are still retained and these give some idea of their character.

The true extent of the postfrontals in the Ceratopsian skull is here correctly determined for the first time. Authorities have heretofore considered the postfrontal as extending from the median line outward and including all of that portion of the skull here designated as postfrontal and postorbital (see pl. 2). In this specimen a longitudinal suture just internal to the base of the supraorbital horn core separates it into two distinct elements. The inner portion all paleontologists agree in calling the postfrontal, the outer appears without question to represent the postorbital. Von Huene,[1] in 1912, in a skull of *Triceratops prorsus* regarded that portion forming the posterior boundary of the orbit as representing the whole of the postorbital, but the writer now questions the correctness of this determination in the genus *Triceratops*, in so far as regarding it as representing the entire postorbital.

In *Brachyceratops* the postfrontal is a somewhat irregularly triangular bone, longer than wide, which unites by suture on the median line with its fellow of the opposite side.

Anteriorly the combined postfrontals terminate in a pointed projection that is interposed between the deeply emarginate posterior borders of the prefrontals. Posteriorly and on either side of the postfrontal foramen these bones articulate by suture with the median element of the frill. A toothed external border unites with the postorbital. Beginning between the horn cores the median upper surfaces of the postfrontals are angularly depressed, gradually deepening and widening transversely as they approach the fontenelle much as in *Styracosaurus albertensis* Lambe, see B, plate II, The Ottawa Naturalist, Vol. 27, 1913.

The postorbital gives rise to the small supraorbital horn core and forms nearly one-half of the orbital border. Posterior to this horn which is situated on the extreme anterior end, the bone flares out into a wide expanded portion, much deflected externally, with a curved posterior border, the inner half of which forms a portion of the outer boundary of the supratemporal fossa, the outer half having an underlapping sutural edge for articulation with the squamosal. The straight inferior edge meets the jugal which is missing in this specimen.

The thickened anterior border shows a sutural edge for union with the missing supraorbital bone. On the median inferior surface is a shallow pit which receives the outer end of the alisphenoid, as it does in *Stegosaurus* and *Camptosaurus*.

---

[1] Neues Jahrbuch, 1912, fig. 3, p. 151.

Immediately above the orbit on the anterior part of the postorbital there rises a low horn core, the upper extremity being obtusely rounded from a lateral aspect, see *po.h* plate 1, but sharply pointed when viewed from the front. The external surface of this horn is plane, the internal strongly convex, with the antero-posterior diameter greatly exceeding the transverse, the total height of the horn above the orbit being 35 mm. These horn cores appear to be outgrowths from the postorbital bones unless they include a posterior supraorbital element such as has recently been found in the skull of *Stegosaurus*. However that may be, there is no trace of such a division in the postorbitals of this specimen. This again raises the question of the proper designation of these horns which have been called successively postfrontal and supraorbital horn cores. If an outgrowth from the postorbital bone, as the present specimen appears to indicate, the term postorbital horn core would be a more appropriate designation.

The prefrontals (the frontals and lachrymals of authors) are deeply emarginate anteriorly and receive between them the pointed posterior ends of the nasals.

The prefrontal is a quadrangular plate of bone diagonally placed filling the interspace between the postfrontal and nasal bones. Its thickened posterior end contributes to the inner part of the anterior boundary of the orbit. Near the posterior termination a narrow vertical sutural surface (*so*, pl. 2) on the external side was for the articulation of the small supraorbital bone that is missing. This element would have completed the thickened projecting orbital border immediately in front of the eye and which forms such a conspicuous feature of the Ceratopsian skull. On the upper posterior end of the prefrontal a pointed peg-like projection is received in a corresponding pit in the anterior border of the postfrontal, thus strengthening the union of these two bones. The prefrontal is just barely in contact with the postorbital at the base of the postorbital horn core.

The relationships of the pre- and postfrontals in *Brachyceratops* is an unusual one, for in most dinosaurian crania the frontal is interposed between them, and so far as the writer is aware the above condition is only found in *Stegosaurus* among the dinosauria and in some of the Permian reptilia. Von Huene has shown, and the writer believes correctly too, that the frontal in *Triceratops* has been entirely excluded from the dorsal surface of the skull.

The frill is represented by the median elements from two individuals. Both have portions missing, but the better preserved one is

provisionally associated with the type as shown in plates 1 and 2. This association, however, is only provisional in so far as it applies to the recognition of the proper individual, for it can be said without question that all the bones found belong to the same kind of an animal.

The dermo-supraoccipital or interparietal, for surely it cannot be the parietal as Hay [1] and von Huene [2] have clearly shown, is united by suture with the anterior portion of the skull at the postfrontal foramen. The median part of the interparietal is sharply ridged, excepting the posterior extremity, where it flattens out into a thinner portion with an emarginate median border. Between the fenestræ the median bar, in cross section, is triangular. The superior surface of this ridge forward of its narrowest part between the fenestræ presents three low longitudinal swellings arranged one in front of the other. Proximally the median portion is greatly compressed transversely into a short neck, forward of which it again widens into a much depressed end that articulates laterally with the postfrontals and with them forms the upper boundaries of the postfrontal foramen, see *fo*, plate 2. Between these two lateral portions the median surface is deeply concave and slopes downward to a heavy truncated border that in all probability was suturally united with the parietals. In *Brachyceratops* at least, the parietal was entirely excluded from the dorsal aspect, and it is presumed that similar conditions obtained in *Triceratops*, although von Huene was inclined to regard a small portion of the median part of the frill posterior to the postfrontal foramen in that genus as being parietal.

The bone surrounding the frill fenestræ is very thin, but toward the lateral free edges and posteriorly it becomes thickened. Proximally it remains thin where it forms the floor of the supratemporal fossa but thickens toward the sutural border for the squamosal. The exact shape and extent of the frill fenestræ cannot be accurately determined from the available specimens, but it is readily apparent that they were of comparatively small size. The surfaces of the frill are relatively smooth and without the ramifying system of vascular grooves of the later Ceratopsians. There were no epoccipital bones on the margins of the frill, but on either side of the median emargination a series of prominences give to the periphery much the same peculiar scalloped effect found in the *Triceratops* frill with its separate ossifications.

---

[1] Proc. U. S. Nat. Mus. vol. 36, 1909, p. 97.
[2] Neues Jährbuch, 1912, pp. 150-156, figs. 3, 4, 5 and 6.

Laterally the median portion unites with the squamosal by a straight sutural edge that is directed forward and inward toward the center of the skull. A triangular outward projection with an upper striated surface at the anterior termination of the squamosal suture represents a surface that was overlapped by the articulated squamosals (*s.s.*, plate 1). A low, sharp, diagonally directed ridge apparently indicates the posterior extent of the overlap of the squamosal. The squamosals are missing, but those as in other primitive Ceratopsians appear to have been short and broad.

The rostral is missing from the type, but is present in a slightly smaller individual (Cat. No. 7952, U. S. Nat. Mus.). (See fig. 2.) In general aspect it resembles the rostral of *Triceratops*, but with a

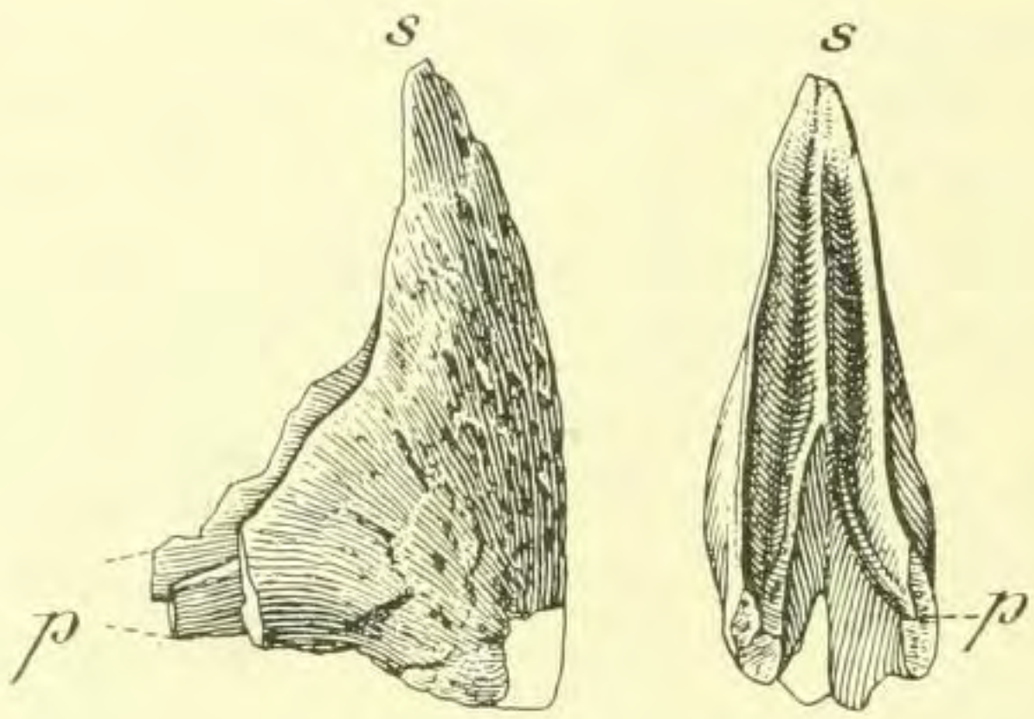


FIG. 2.—Rostral of *Brachyceratops montanensis*. Paratype: Cat. No. 7952 U. S. Nat. Mus., ½ nat. size. *a*, side view; *b*, posterior view; *s*, superior process; *p*, posterior processes.

less curved anterior border. Externally the surfaces are pitted and grooved and in life were doubtless covered by a horny sheath.

The predentary except for its much smaller size is indistinguishable from that of *Triceratops*. It is to be distinguished from the predentary of *Monoclonius dawsoni* Lambe by the upward turned apex of the anterior end.

The dentary is stout, gradually narrowing vertically toward the front, the anterior end being especially depressed and unusually broad transversely, this end being nearly at right angles to the posterior portion. Near the posterior end on the external surface a stout coronoid process is developed, extending well above the dental border. It is compressed transversely but widens antero-posteriorly with a hooked forward process as in other primitive Ceratopsians. Beginning at the base of this process, a low, broad ridge extends

forward at about mid-height along the outer side of the dentary. Above and below this ridge the outer surface retreats obliquely inward.

Viewed from above, the dental border is straight but is obliquely placed in relation to the lower portion, that is, it passes from the inner posterior margin to the outer anterior margin of the jaw. Beneath the coronoid process there is a deep mandibular fossa which extends forward about one-third the length of the dentary. On the inner side there is the usual row of foramina, leading into the dental chamber. The exact number of alveoli cannot be determined at this time, although the tooth series is relatively shorter than in either *Ceratops* or *Triceratops*.

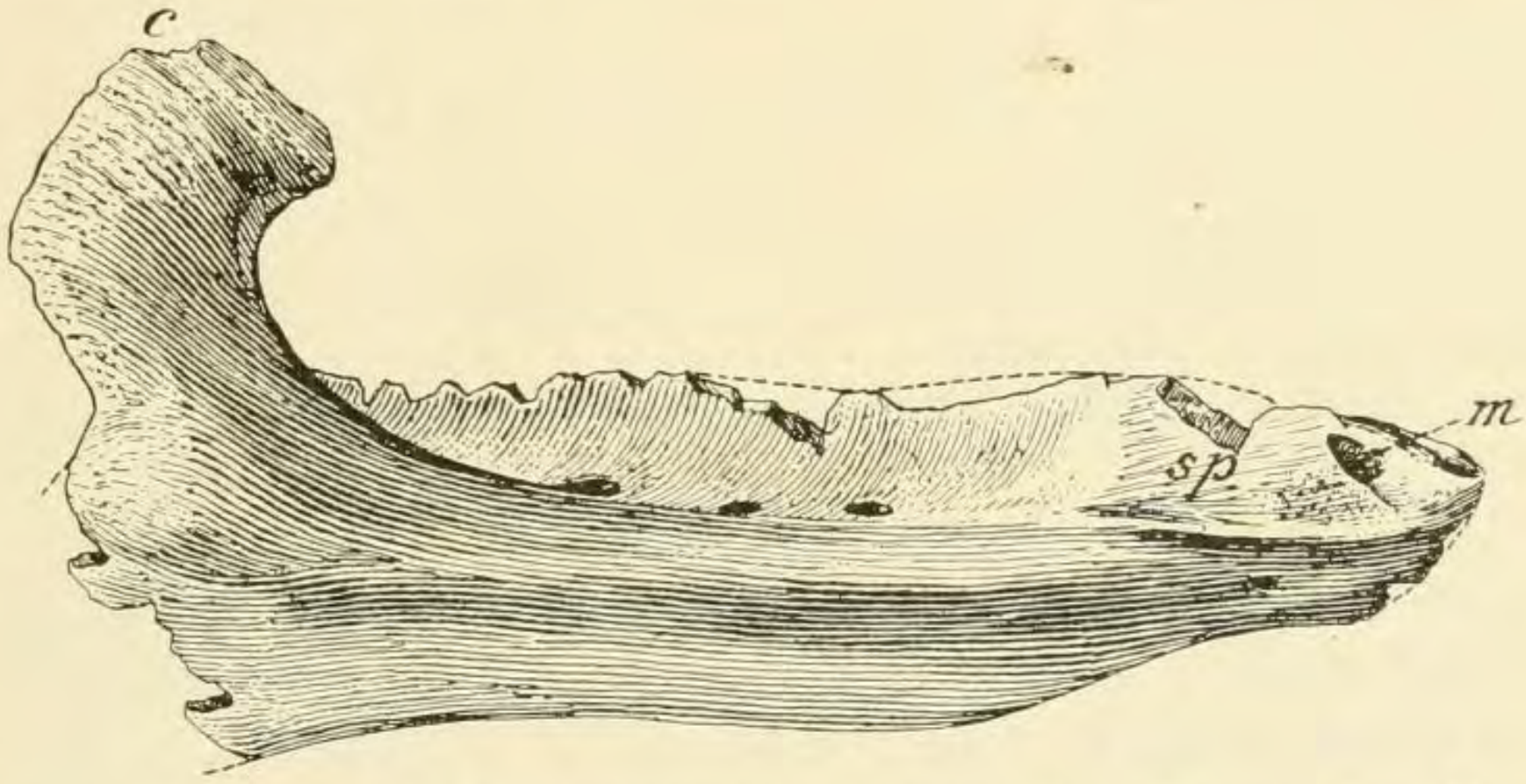


FIG. 3.—Dentary of *Brachyceratops montanensis*. Type: Cat. No. 7951 U. S. Nat. Mus., ½ nat. size. *c*, coronoid process; m, mental foramen; *sp*, surface for predentary.

At this time little can be said regarding the affinities of *Brachyceratops*, though it would appear most nearly allied to *Monoclonius*, as shown by its small size, the small brow horns of similar shape, large nasal horn and crenulated margin of the frill without separate marginal ossifications.

It is readily distinguished, however, from all known Ceratopsians by the longitudinal suture of the nasal horn, the small fenestræ wholly within the median frill element, and the greatly abbreviated facial portion of the skull. It is also apparent that there are other distinguishing features in the skeleton which is to be described later.

The striking resemblance of the fragment of a skull figured by Hatcher as *Monoclonius crassus*[1] to the homologous parts of the

[1]Monog. U. S. Geol. Survey, Vol. 49, 1907, p. 74, fig. 76.

present specimen leads the writer to suggest its possible identification with the present genus. Hatcher regarded it as belonging to a smaller and distinct individual from the type of that species and he also observes: "I describe and figure this element in this connection not out of regard for any certain additional characters it may furnish distinctive of the present genus and species [*Monoclonius crassus*] but rather for the information which it affords relative to the homologies of certain cranial elements in the Ceratopsia as a group." The great similarity of the horn-cores with those of *Brachyceratops* lends much color to the above suggestion.

MEASUREMENTS

	mm.
Greatest length of skull, about	565
Greatest breadth of skull, estimated	400
Expanse of frontal region at base of brow horn cores	90
Greatest width of nasals	58
Length of interparietal along median line	315
Height of nasal horn core above border of narial orifice	125
Greatest width of postfrontals	80
Greatest length of combined post- and prefrontals	126

NOTE ON HYPACROSAURUS

I wish to announce the discovery in northwestern Montana, in beds equivalent to the upper part of the Belly River formation, of the Trachodont reptile *Hypacrosaurus*.[1] A considerable portion of the skeleton (Cat. No. 7948, U. S. Nat. Mus.) of one individual was recovered, and at this time (the specimen not being entirely prepared) I am unable to distinguish it specifically from the type and only known species, *H. altispinus* Brown, from the Edmonton Cretaceous of Canada.

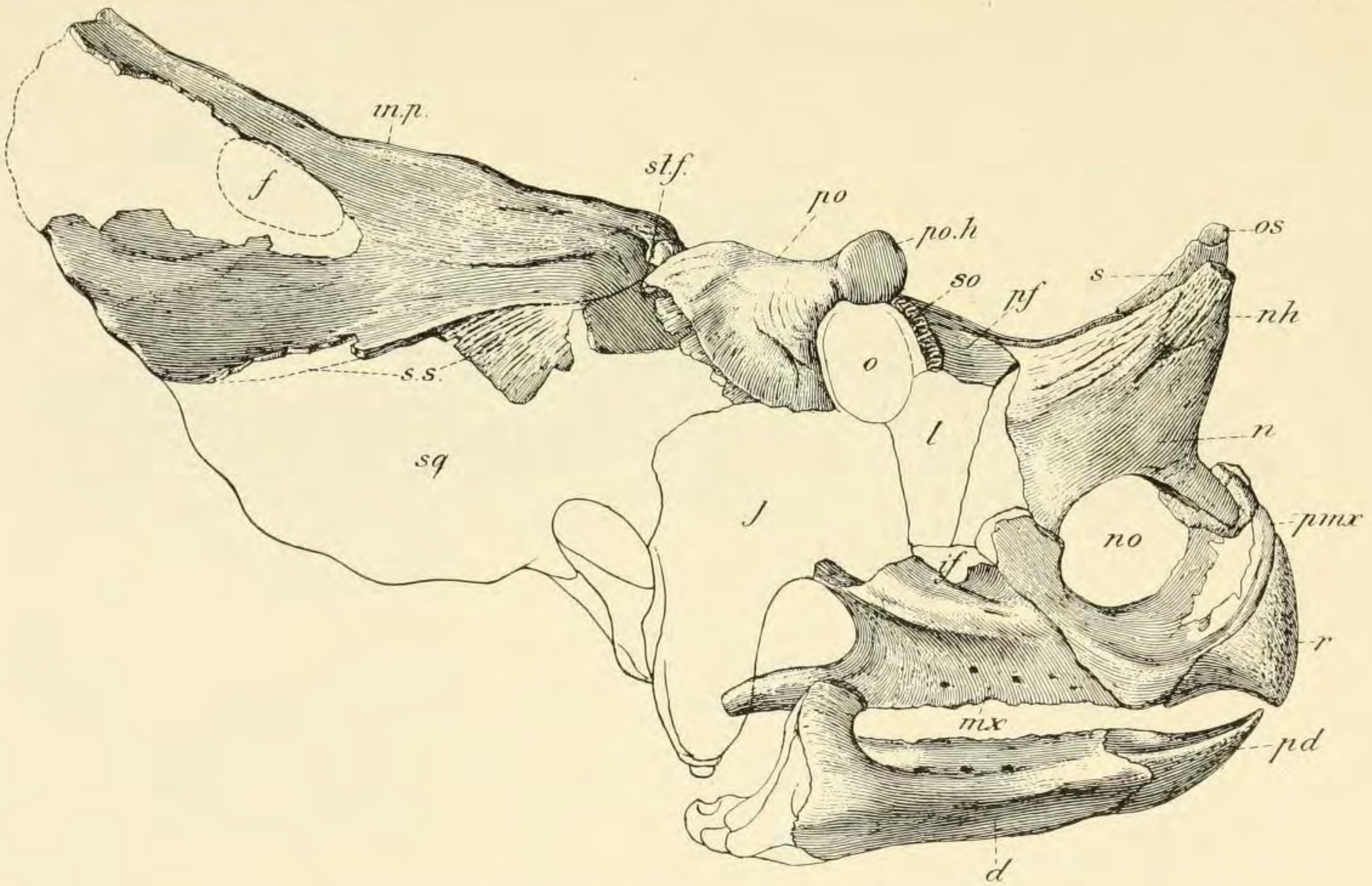
[1] Barnum Brown: A New Trachodont Dinosaur Hypacrosaurus, from the Edmonton Cretaceous of Alberta. (*Bull. Amer. Mus. Nat. Hist.*, Vol. 32, 1913, pp. 395-406.)

EXPLANATION OF PLATE 1

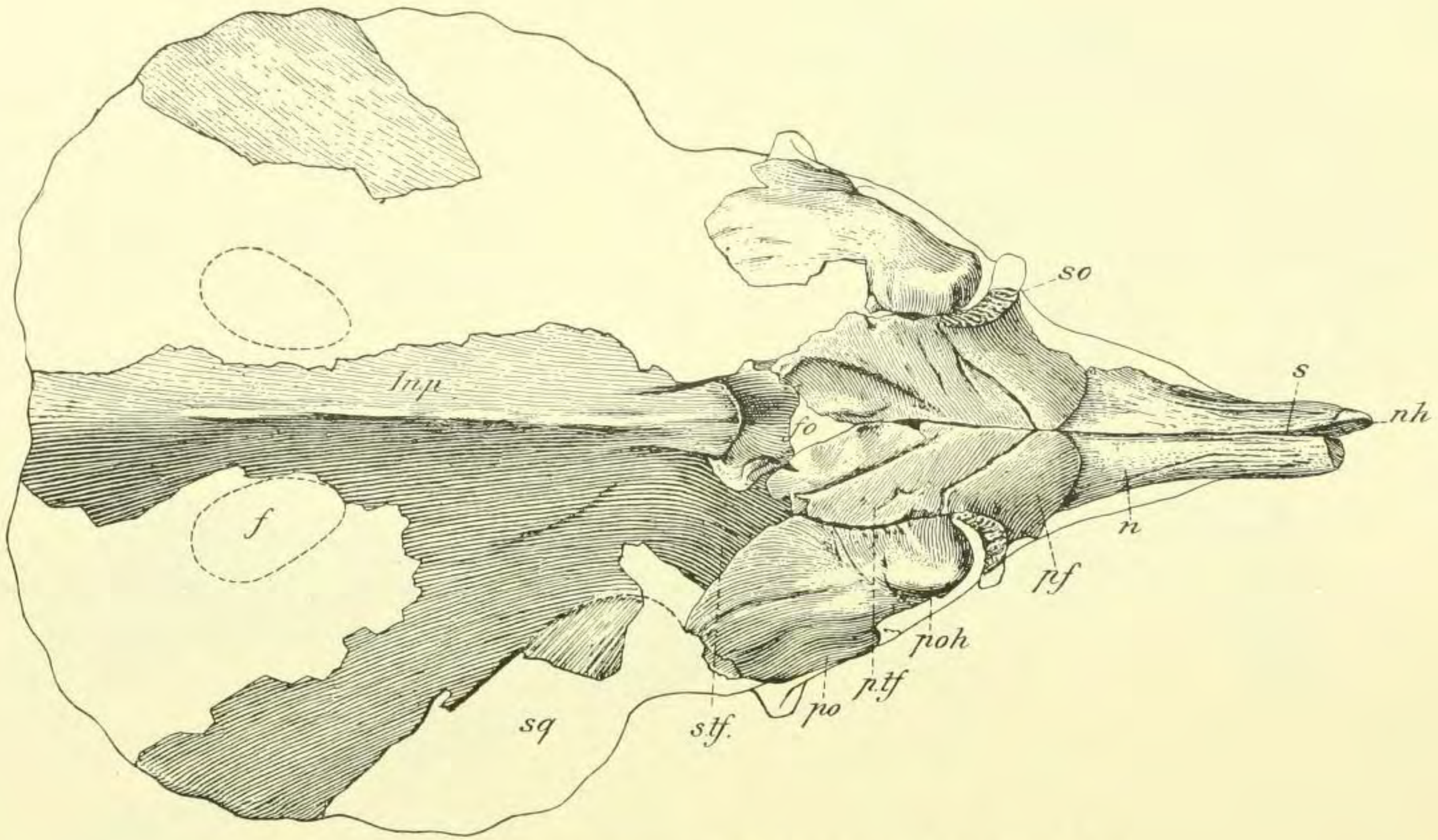
Lateral view of the skull of *Brachyceratops montanensis*. Type: Cat. No. 7951 U. S. Nat. Mus., ¼ nat. size. *d*, dentary; *f*, fenestra in frill; *if*, infra-orbital foramen; *in.p*, interparietal; *j*, jugal; *l*, lachrymal; *mx*, maxillary; *n*, nasal; *nh*, nasal horn cores; *no*, anterior narial opening; *o*, orbit; *os*, ossicle on top of nasal horn core; *pd*, predentary; *pf*, prefrontal; *pmx*, premaxillary; *po*, postorbital; *po.h*, postorbital horn core; *r*, rostral; *s*, suture separating halves of nasal horn; *sq*, squamosal; *so*, sutural border on prefrontal for small supraorbital; *s.s*, sutural surfaces for squamosal; *st.f*, supratemporal fossa.

EXPLANATION OF PLATE 2

Superior view of the skull of *Brachyceratops montanensis*. Type: Cat. No. 7951 U. S. Nat. Mus., ¼ nat. size. *f*, fenestra in frill; *fo*, postfrontal foramen; *in.p*, interparietal; *n*, nasal; *nh*, nasal horn cores; *pf*, prefrontal; *po*, postorbital; *poh*, postorbital horn core; *p.tf*, postfrontal; *s*, suture representing halves of the nasal horn core; *so*, sutural border for missing supra-orbital bone; *sq*, squamosal; *s.tf*, supratemporal fossa.



LATERAL VIEW OF SKULL OF BRACHYCERATOPS MONTANENSIS



SUPERIOR VIEW OF SKULL OF BRACHYCERATOPS MONTANENSIS

The following text is generated from uncorrected OCR.

[Begin Page: Page 1]

A NEW CERATOPSIAN DINOSAUR FROM THE UPPER CRETACEOUS OF MONTANA, WITH NOTE ON HYPACROSAURUS '

By CHARLES W. GILMORE

assistant curator of fo.ssii, reptiles, u. s. national museum.

(With Two Plates)

INTRODUCTION

The fossil remains upon which the present communication is l)ased were collected by the writ^er during the summer of 1913 while working under the auspices of the U. S. Geological Survey on the lUackfeet Indian Reservation in northwestern Montana. The partial skeletons of five individuals were found and these supplement one another to such an extent that nearly all parts of the skeleton are represented. The skull presents some anatomical features not heretofore known in the Ceratopsia and the new genus and species Brachyccratops iiiontancnsis is here proposed.

This new form is the smallest known re]>resentative among the

Ceratopsian dinosaurs and in several respects strikingly different from any of its allied contemporaries.

The present paper is preliminary. Upon the completion of the preparatory work now in progress a more detailed account of the skeletal anatomy and a discussion of its affinities will be given.

BRACHYCERATOPS MONTANENSIS, new genus and species

Type. — Cat. No. 7951 U. S. Xat. Mus. A considerable portion of a disarticulated skull ii. e., nasals, prefrontals, postfrontals,])Ostorbitals, premaxillaries, maxillaries, alisphenoid), with which is provisionally associated a fragmentary part of the frill and a right dentary and a predentary.

Type locality.— N. E. >4 Sec. 16, T 37 N, R 8 W. Milk River, Ijlackfeet Indian Reservation, Teton County, Montana.

Paratypes. — Cat. No. 7952, U. S. Nat. ^lus. Rostral and portions of the premaxillaries; Cat. No. 7953 U. S. Nat. Mus. Sacrum,

' Published by])ermission of the Director of the U. S. Geological Survey.
Smithsonian Miscellaneous Collections. Vol. 63, No. 3

[Begin Page: Page 2]

complete pelvis and articulated caudal series of 45 vertebrje continuing to the tip of the tail; Cat. No. 7957, U. S. Nat. Mus. Tw^o tarsals of the distal row, four articulated metatarsals, a portion of the fifth, and eleven phalanges.

Localities. — Same as the type.

Horizon. — From the upper part of an Upper Cretaceous formation soon to be described by the U. S. Geological Survey, which includes the equivalent of the Judith River formation and some older beds. The fossiliferous horizon is also the equivalent of the upper part of the Belly River formation, as described in neighboring areas of Canada.

Generic and specific characters. — Typically of small size. Skull with facial portion much abbreviated, and deep vertically. Supraorbital horn cores small. Nasal horn core outgrowth from nasals, large, slightly recurved, laterally compressed, and divided longitudinally by median suture. Frill with comparatively sharp median crest, fenestrse apparently of small size, and entirely within the median element. Supratemporal fossae opening widely behind. Border of frill scalloped, but without separate marginal ossifications. Dentition as compared with Triceratops greatly reduced.

Description of skull. — The description to follow is devoted entirely to a consideration of the skull, since it shows characters of sufficient importance to readily distinguish it from all the other known members of the Ceratopsian group, which in the greater num-

ber of instances have also been established upon cranial material.

When found, the skull was entirely disarticulated, but the excellent state of preservation of the bone and the absence of distortion by crushing rendered the assembling of the scattered elements a comparatively easy matter. This specimen is of the utmost importance in the evidence it gives for the proper interpretation of the cranial elements, and especially the positive information it affords relating to those parts of the Ceratopsian cranium now somewhat in controversy.

In the above diagnosis of the genus and species, it is stated to be typically of small size. While this statement is true so far as applied to the known specimens, it should also be stated that to some extent the small size of these specimens may be due to the immaturity of the individuals. The open sutures of the skull, sacrum, and vertebra? all testify to the youth of the animals.

Viewing the skull in profile (pi. i), one is especially impressed by the great abbreviation of the facial portion, when compared with the

[Begin Page: Page 3]

Ceratopsians of the Lance formation. It is to this shortening that the generic name refers. The narial opening, as in other known

Judith River and Belly River forms, is situated well forward and under the nasal horn, whereas in the later and more, highly specialized Tricciatops this orifice is ^entirely posterior to that horn. The distance between the nasal and supraorbital horns, as seen in the upper outline, is exceedingly short, due largely to the shortened nasal bones and the great fore and aft development of the basal portion of the nasal horn and also to the forward position over the orbits of the small brow horns.

The exact pitch of the frill portion in relation to the anterior part of the skull cannot be positively determined, though in the drawing it has been placed in accordance with the evidence of articulated skulls.

This specimen brings to light an entirely new phase of nasal horn development and one which, so far as our previous knowledge goes, appears to be unique among dinosaurs. Reference is made here to the longitudinal separation of the horn core into two halves by the nasal suture. This also indicates the nasal horn to be an outgrowth from the nasal bones instead of having originated from a separate center of ossification, as is the case in the more specialized Triceratops. It appears quite probable there are some of the described Belly River species that will also show a similar mode -of nasal horn development when juvenile specimens are found.

The nasals are especially deep and massive, due to the development on their superior surfaces of the nasal horn cores. Posteriorly they present a pointed process with a beveled underlapping surface for contact with the prefrontals (the frontals and lachrymals of

authors). Laterally they send down a deep extension to meet the premaxillary, and anteriorly the arched ventral borders of the nasal bones form the upper half of the boundary of the narial orifice. Anteriorly they send out vertically flattened processes (see p, fig. i) between which are received the ascending processes of the premaxillas. This nasal process appears to end about 32 mm. in advance of the forward line of the horn core, so that the upper outline of the beak is formed largely by the premaxillaries. The horn has a broad fore and aft extent at its base, but tapers rapidly to a bluntly pointed horn of moderate height. Transversely it is much compressed at the base, though inclined to expand somewhat toward the summit. The horn as a whole is directed somewhat forward, but the curve of the posterior side is such as to give the impression

[Begin Page: Page 4]

that its upper part is slightly recurved. The surfaces of the upper half are roughened and grooved by vascular impressions.

On the tip of the left half of the nasal horn is a small, flattened oval bony ossicle, which rests in a shallow depression or pit on the apex of the horn as shown at os, figure i. This ossicle is a distinct element from the underlying bone and may represent the incipient horn of later Ceratopsians where it is known to be developed from a center of ossification distinct from the nasal bones.

'OS

Fig. i. — Nasals and nasal horn cores of Brachyccratops montancnsis. Type : Cat. No. 7951 U. S. Nat. Mus., Yi Nat. size. A, side view; B, front view; c, surface for contact with the premaxillaries ; /, surface for articulation of pre-frontal ; no. anterior nasal opening; os, ossicle on top of horn core; p, anterior process of nasal ; po, orifice for superior processes of premaxillaries ; s, suture separating two halves of nasal horn.

The maxillaries are of triangular outline with alveoli for twenty teeth in the functional row. As compared wath Triccratops this is a greatly reduced number, Triccratops having forty alveoli in the maxillary. In this specimen all of the functional teeth have fallen out, but two or more germ teeth are still retained and these give some idea of their character.

[Begin Page: Page 5]

The true extent of the postfroiitals in the Ceratopsian skull is here correctly determined for the first time. Authorities have heretofore considered the post frontal as extending from the median line out-ward and including all of that portion of the skull here designated as postf rental and postorbital (see pi. 2). In this specimen a longi-tudinal suture just internal to the base of the supraorbital horn

core separates it into two distinct elements. The inner portion all paleontologists agree in calling the postfrontal, the outer appears without question to represent the postorbital. Von Huene/ in 191 2, in a skull of Triccratops prorsus regarded that portion forming the posterior boundary of the orbit as representing the whole of the post-orbital, but the writer now questions the correctness of this determination in the genus Triccratops, in so far as regarding it as representing the entire postorbital.

In Brachyceratops the postfrontal is a somewhat irregularly triangular bone, longer than wide, which unites by suture on the median line Avith'its fellow of the opposite side.

Anteriorly the combined postfrontals terminate in a pointed projection that is interposed between the deeply emarginate posterior borders of the prefrontals. Posteriorly and on either side of the postfrontal foramen these bones articulate by suture with the median element of the frill. A toothed external border unites with the post-orbital. Beginning between the horn cores the median upper surfaces of the postfrontals are angularly depressed, gradually deepening and widening transversely as they approach the fontenelle much as in Styracosaurus alhertcnsis Lambe, see E, plate II, The Ottawa Naturalist, Vol. 27, 1913.

The postorbital gives rise to the small supraorbital horn core and forms nearly one-half of the orbital border. Posterior to this horn which is situated on the extreme anterior end, the bone flares out into a wide expanded portion, much deflected externally, with a

curved posterior border, the inner half of which forms a portion of the outer boundary of the supratemporal fossa, the outer half having an underlapping sutural edge for articulation with the squamosal. The straight inferior edge meets the jugal which is missing in this specimen.

The thickened anterior border shows a sutural edge for union with the missing supraorbital bone. On the median inferior surface is a shallow pit which receives the outer end of the alisphenoid, as it does in Stegosaitnts and Camptosaurus.

' Neues Jahrbuch, 1912, fig. 3, p. 151.

[Begin Page: Page 6]

Immediately above the orbit on the anterior part of the postorbital there rises a low horn core, the upper extremity being obtusely rounded from a lateral aspect, see po.h plate i, but sharply pointed when viewed from the front. The external surface of this horn is plane, the internal strongly convex, with the antero-posterior diameter greatly exceeding the transverse, the total height of the horn above the orbit being 35 mm. These horn cores appear to be outgrowths from the postorbital bones unless they include a posterior supraorbital element such as has recently been found in the skull of Stegosaurns. However that may be, there is no trace of such a

division in the postorbitals of this specimen. This again raises the question of the proper designation of these horns which have been called successively postfrontal and supraorbital horti cores. If an outgrowth from the postorbital bone, as the present specimen appears to indicate, the term postorbital horn core would be a more appropriate designation.

The prefrontals (the frontals and lachrymals of autliors) are deeply emarginate anteriorly and receive between them the pointed posterior ends of the nasals.

The prefrontal is a c|uadrangular plate of bone diagonally placed filling the interspace between the postfrontal and nasal bones. Its thickened posterior end contributes to the inner part of the anterior boundary of the orbit. Near the posterior termination a narrow vertical sutural surface {so, pi. 2) on the external side was for the articulation of the small supraorbital bone that is missing. This element would have completed the thickened projecting orbital border immediately in front of the eye and which forms such a conspicuous feature of the Ceratopsian skull. On the upper posterior end of the prefrontal a pointed peg-like projection is received in a corresponding pit in the anterior border of the postfrontal, thus strengthening the union of these two bones. The prefrontal is just barely in contact with the postorbital at the base of the postorbital horn core.

The relationships of the pre- and postfrontals in Brachyccratops is an unusual one, for in most dinosaurian crania the frontal is interposed between them, and so far as the writer is aware the above condition is only found in Stegosaurus among the dinosauria and in

•some of the Permian reptilia. Von Huene has shown, and the writer believes correctly too, that the frontal in Triceratops has been entirely excluded from the dorsal surface of the skull.

The frill is represented by the median elements from two individuals. Both have portions missing, but the better preserved one is

[Begin Page: Page 7]

provisionally associated with the type as shown in plates i and 2. This association, however, is only provisional in so far as it applies to the recognition of the proper individual, for it can be said without question that all the bones found belong to the same kind of an animal.

The dermo-supraoccipital or interparietal, for surely it cannot be the parietal as Hay ' and von Huene ' have clearly shown, is united by suture with the anterior portion of the skull at the postfrontal foramen. The median part of the interparietal is sharply ridged, excepting the posterior extremity, where it flattens out into a thinner portion with an emarginate median border. Between the fenestrse the median bar, in cross section, is triangular. The superior surface of this ridge forward of its narrowest part between the fenestrse presents three low longitudinal swellings arranged one in front of the other. Proximally the median portion is greatly compressed

transversely into a short neck, forward of which it again widens into a much depressed end that articulates laterally with the postfrontals and with them forms the upper boundaries of the postfrontal foramen, see jo, plate 2. Between these two lateral portions the median surface is deeply concave and slopes downward to a heavy truncated border that in all probability was suturally united with the parietals. In Brachyceratops at least, the parietal was entirely excluded from the dorsal aspect, and it is presumed that similar conditions obtained in Triceratops, although von Huene was inclined to regard a small]:)ortion of the median part of the frill posterior to the postfrontal foramen in that genus as being parietal.

The bone surrounding the frill fenestrse is very thin, but toward the lateral free edges and posteriorly it becomes thickened. Proximally it remains thin where it forms the floor of the supratemporal fossa but thickens toward the sutural border for the squamosal. The exact shape and extent of the frill fenestrae cannot be accurately determined from the available specimens, but it is readily apparent that they were of comparatively small size. The surfaces of the frill are relatively smooth and without the ramifying system of vascular grooves of the later Ceratopsians. There were no epoccipital bones on the margins of the frill, but on either side of the median emargination a series of prominences give to the periphery much the same peculiar scalloped effect found in the Triceratops frill with its separate ossifications.

^ Proc. U. S. Nat. Mus. vol. 2,^, 1909, p. 97.

' Neues Jahrbuch, 1912, pp. 150-156, figs. 3, 4, 5 and 6.

[Begin Page: Page 8]

Laterally the median portion unites with the squamosal by a straight sutural edge that is directed forward and inward toward the center of the skull. A triangular outward projection with an upper striated surface at the anterior termination of the squamosal suture represents a surface that was overlapped by the articulated squamosals (s.s., plate I). A low. sharp, diagonally directed ridge apparently indicates the posterior extent of the overlap of the squamosal. The squamosals are missing, but those as in other primitive Ceratopsians appear to have been short and broad.

The rostral is missing from the type, but is present in a slightly smaller individual (Cat. No. 7952, U. S. Nat. Alus.). (See fig. 2.) In general aspect it resembles the rostral of Triceratops, but wdth a

/>

Fig. 2. — Rostral of Brachyceratops)iioiitaiicnsis. Paratype : Cat. No. 7952 U. S. Nat. Mus., 14 nat. size. a. side view ; b, posterior view ; s. superior process ; p, posterior processes.

less curved anterior border. Externally the surfaces are pitted and

grooved and in life were doubtless covered by a horny sheath.

The predentary except for its much smaller size is indistinguishable from that of Triceratops. It is to be distinguished from the predentary of Monocloniiis dazvsoiii Lambe by the upward turned apex of the anterior end.

The dentary is stout, gradually narrowing vertically toward the front, the anterior end being especially depressed and unusually broad transversely, this end being nearly at right angles to the posterior portion. Near the posterior end on the external surface a stout coronoid process is developed, extending well above the dental border. It is compressed transversely but widens antero-posteriorly with a hooked forward process as in other primitive Ceratopsians. Beginning at the base of this process, a low, broad ridge extends

[Begin Page: Page 9]

forward at about mid-height along the outer side of the dentary. Above and below this ridge the outer surface retreats obliquely inward.

\'iewed from above, the dental border is straight but is obliquely

placed in relation to the lower portion, that is, it passes from the inner posterior margin to the outer anterior margin of the jaw. Beneath the coronoid process there is a deep mandibular fossa which extends forward about one-third the length of the dentary. On the inner side there is the usual row of foramina, leading into the dental chamber. The exact number of alveoli cannot be determined at this time, although the tooth series is relatively shorter than in either Ccratops or Triceratops.

,TrL

Fig. 3. — Dentary of Brachyccraiops iiw)itancnsis. Type: Cat. No. 7951 U. S. Nat. Mus., 1/2 nat. size, c, coronoid process ; m, mental foramen ; sp, surface for predentary.

At this time little can be said regarding the affinities of Brachyceratops, though it would appear most nearly allied to Monoclonius, as shown by its small size, the small brow horns of similar shape, large nasal horn and crenulated margin of the frill without separate marginal ossifications.

It is readily distinguished, however, from all known Ceratopsians by the longitudinal suture of the nasal horn, the small fenestrse wholly within the median frill element, and the greatly abbreviated facial portion of the skull. It is also apparent that there are other distinguishing features in the skeleton which is to be described later.

The striking resemblance of the fragment of a skull figured by

Hatcher as Monoclon'uis crassns ' to the homologous parts of the

'Monog. U. S. Geol. Survey, Vol. 49, 1907, p. 74, fig. 76.

[Begin Page: Page 10]

present specimen leads the writer to suggest its possible identification with the present genus; Hatcher regarded it as belonging to a smaller and distinct individual from the type of that species and he also observes : " I describe and figure this element in this connection not out of regard for any certain additional characters it may furnish distinctive of the present genus and species [Monoclonius crassus] but rather for the information which it affords relative to the homologies of certain cranial elements in the Ceratopsia as a group."
The great similarity of the horn-cores with those of Brachyceratops lends much color to the above suggestion.

MEASUREMENTS ^,„_

Greatest length of skull, about 565

Greatest breadth of skull, estimated 400

Expanse of frontal region at base of brow horn cores 90

Greatest width of nasals 58

Length of interparietal along median line 3i5

Height of nasal horn core above border of narial orifice 125

Greatest width of postf rontals 80

Greatest length of combined post- and prefrontals 126

NOTE ON HYPACROSAURUS

I wish to announce the discovery in northwestern Montana, in beds equivalent to the upper part of the Belly River formation, of the Trachodont reptile Hypacrosaurus^ A considerable portion of the skeleton (Cat. No. 7948, U. S. Nat. Mus.) of one individual was recovered, and at this time (the specimen not being entirely prepared) I am unable to distinguish it specifically from the type and only known species, H. altispinus Brown, from the Edmonton Cretaceous of Canada.

^Barnum Brown: A New Trachodont Dinosaur Hypacrosaurus, from the Edmonton Cretaceous of Alberta. (Bull. Amer. Mus. Nat. Hist., Vol. 32, 1913. pp. 395-406.) '

[Begin Page: Text]

I

i

[Begin Page: Text]

EXPLANATION OF PLATE i

Lateral view of the skull of Brachyccratops montaiiensis. Type : Cat. No. 7951 U. S. Nat. Mus., }i nat. size, d, dentary ; /, fenestra in frill ; if, infra-orbital foramen; in.p, interparietal; ;', jugal; /, lachrymal; vix, maxillary; n, nasal ; nh, nasal horn cores ; no, anterior narial opening ; 0, orbit ; os, ossicle on top of nasal horn core ; pd, predentary ; pf, prefrontal ; pm.v, premaxillary ; po, postorbital ; po.h, postorbital horn core ; r, rostral ; s, suture separating halves of nasal horn ; sq, squamosal ; so, sutural border on prefrontal for small supraorbital ; .y...?, sutural surfaces for squamosal ; st.f, supratemporal fossa.

EXPLANATION OF PLATE 2

Superior view of the skull of Brachyccratops montaiiensis. Type: Cat. No. 7951 U. S. Nat. Mus., %. nat. size. /, fenestra in frill; fo, postfrontal fora-men; in.p, interparietal; n, nasal; nh, nasal horn cores; pf, prefrontal; po, postorbital; poh, postorbital horn core; p.tf, postfrontal; s, suture repre-senting halves of the nasal horn core ; so, sutural border for missing supra-orbital bone ; sq, squamosal ; s.tf, supratemporal fossa.

[Begin Page: Text]

[Begin Page: Text]