Dr O. P. Hay -
with kind regards of
Henry F. Osborn

GEOLOGICAL SURVEY OF CANADA

ROBERT BELL, M.D., Sc.D. (Cantab.), LL.D., F.R.S.

CONTRIBUTIONS

TO

CANADIAN PALÆONTOLOGY

VOLUME III (Quarto).

PART II. ON VERTEBRATA OF THE MID-CRETACEOUS OF THE NORTH WEST TERRITORY

BY

HENRY FAIRFIELD OSBORN,
Vertebrate Palæontologist (Honorary) of the Survey,

AND

LAWRENCE M. LAMBE,
Assistant Palæontologist.

1.—DISTINCTIVE CHARACTERS OF THE MID-CRETACEOUS FAUNA.
By HENRY FAIRFIELD OSBORN.

2.—NEW GENERA AND SPECIES FROM THE BELLY RIVER SERIES (MID-CRETACEOUS).
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OTTAWA
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SEPTEMBER 1902

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The present report, on Vertebrata from the Mid-Cretaceous rocks of the North-west Territory of Canada, forms the second part of a "series of descriptive and illustrated quarto memoirs" begun in 1891.

The first part, by the late Professor E. D. Cope, is on "The species from the Oligocene or Lower Miocene beds of the Cypress Hills".

The publication of a contemplated second part on the Vertebrata of the Laramie formation of the North-west Territory, also by Professor Cope, was prevented by his death in 1897.

The Survey is deeply indebted to Professor Henry Fairfield Osborn, Curator of the Department of Vertebrate Palæontology of the American Museum of Natural History, New York, for having kindly consented, at the request of the late Dr. George M. Dawson, to supervise the working up of the vertebrate fossils in its possession. This assistance has been given quite gratuitously by Professor Osborn, who, besides having twice visited Ottawa in this connection, has also devoted some time to the consideration of the more general geological and palæontological relations of some of these fossils, as set forth in his introduction.

In the preparation of the present report Mr. Lambe has had the advice and supervision of Professor Osborn.

ROBERT BELL.

GEOLOGICAL SURVEY DEPARTMENT,
OTTAWA, 30th July, 1902.

GEOLOGICAL SURVEY OF CANADA.

1—DISTINCTIVE CHARACTERS OF THE MID-CRETACEOUS FAUNA.

BY

HENRY FAIRFIELD OSBORN

GEOLOGICAL SURVEY OF CANADA

1.—DISTINCTIVE CHARACTERS OF THE MID-CRETACEOUS FAUNA.

By Henry Fairfield Osborn

The determination by the Canadian Survey of a Mid-Cretaceous and fresh-water fauna, including fishes, batrachians, reptiles and mammals, is a forward step of great importance in vertebrate palæontology.

The Survey had established beyond question, geologically, that the Belly River series is Mid-Cretaceous, that it underlies the Montana or Ft. Pierre-Fox Hills group, and overlies the Ft. Benton and Dakota groups; * and at the outset of the palæontological investigations for this report, the question arose, what stages of vertebrate evolution are represented by the Belly River fauna?

It soon appeared to the writer in the study of the fine collection made by Mr. Lambe that the Belly River vertebrates of the North-west Territory were of decidedly different and *apparently* of older type than those from the Laramie beds of Converse co., Wyoming, described by Marsh, and were rather to be compared with those described by Leidy, Cope and Marsh, from Montana, chiefly from the Judith River beds, a region by no means distant geographically.

Thus the correlation between the Belly River and Judith River series, proposed by the late Director, Dr. G. M. Dawson, in 1875, at first glance appeared to be confirmed faunistically. But this correlation is not supported by the geological records, which all place the Judith River beds proper *above* the Fox Hills and Fort Pierre.

To present the evidence for and against the Mid-Cretaceous age of some of the Montana fossils already known, to show the need of closer examination of the geology and closer comparison of types, and to outline the general characteristics of this fauna, are the chief objects of this introduction. *Non geologia sine palæontologia*; in other words, no faunal work will endure which is not based on stratigraphical work.

1. Geological Relations.

Among geologists of the United States there has never been any question as to the Laramie or Upper Cretaceous age of the typical Judith River beds. In 1877, Cope referred the Judith River formation of Meek and Hayden to the Cretaceous. In 1887, he

* The history of this work is presented by Mr. Lambe in the second part of this memoir.

questioned Dr. Dawson's assignment of greater age to the Belly River series, holding that the vertebrates were similar to those of the Laramie. C. A. White* takes a similar view: "What gives this (Belly River) formation especial interest is the intimate relation of its fauna and flora to those of the Laramie, although these two non-marine formations are, in the district within which both are known to occur, separated by a great thickness of strata which are unmistakably of marine origin." Whitman Cross** places the Judith River beds even higher: "Without reviewing in detail the literature of these beds, it is desired to point out the fact that the Judith River strata may perhaps represent the Arahapahoe or some other post-Laramie formation and not the true Laramie of Colorado and Wyoming."

Other observations, however, point to the presence of *older* fresh-water beds in Montana, which may have been more or less confused by collectors with the Judith River beds. White, remarks, (op. cit. p. 174): "Certain observed conditions of strata exposed along the Missouri river in northern Montana apparently indicate its [*i. e.* Belly River formation] presence there. It also seems not improbable that some of the strata in the upper part of the valley of the Musselshell river, in Montana, which have been referred to the Laramie, really belonged to the Belly River formation. If strata of this formation really exist there they probably were originally continuous with those of the Belly River valley." More recently Earl Douglas*** has observed Mid-Cretaceous dinosaurs below the Ft. Pierre beds, in Sweet-grass county, Missouri.

In the records as they stand, therefore, there is evidence, first, of fresh-water dinosaur-bearing beds in Montana *older* than the Laramie; and this suggests the possibility, not to say probability, of confusion in the collections; that is some of the vertebrates already described from Montana may be of Belly River age.

Neither in the writings of Cope nor Marsh is the fact recognized that some of the Montana vertebrates are of different and perhaps more ancient character. Even in their latest contributions **** to the subject, Montana and Wyoming vertebrates are discussed as of the same age, and as if the question were one of priority of nomenclature rather than the more important one of priority of structure and time. Marsh (op. cit., p. 145) places the "Ceratops Beds of Laramie Series" above the Fox Hills group, as the summit of the Cretaceous. He defines (op. cit., p. 207) these beds as follows:—

(p. 207). "The definite horizon in which these strange reptiles occur has been called by the writers the Ceratops beds, from the type genus Ceratops, and its position is shown in the section on page 145.... This geological horizon is a distinct one in the upper Cretaceous, and is indicated for more than 800 miles along the eastern flank of the Rocky Mountains. It is marked at nearly every outcrop by remains of these reptiles, and hence the strata containing them have been called the Ceratops beds. They are fresh-water or brackish deposits which form a part of the so-called Laramie, but are below the uppermost beds referred to that group. In some places, at least, they rest upon marine beds, which contain invertebrate fossils characteristic of the Fox Hills deposits The most important localities in the Ceratops beds are in Wyoming, especially in Converse County.... The fossils associated with the Ceratopsidæ are mainly dinosaurs, representing one or two orders and several families. Plesiosaurs, crocodiles, and turtles, of Cretaceous types, and many smaller reptiles, have left their remains in the

* U. S. Geological Survey, Correlation Papers, Cretaceous, 1891, p. 173.

** Geology of the Denver Basin in Colorado. Monographs of the U. S. Geological Survey, Vol. XXVII, p. 239.

*** *Science*, January 3, 1902, p. 31, "Dinosaurs in the Ft. Pierre shales and underlying beds in Montana."

**** Cope, "The Horned Dinosauria of the Laramie", *American Naturalist*, 1889, p. 715.
Marsh, "Dinosaurs of North America," 1895.

same deposits. Numerous small mammals, also of ancient types, a few birds, and many fishes, are likewise entombed in this formation. Invertebrate fossils and plants are not uncommon in the same horizon .... (p. 203). Besides these there were still others related to the Jurassic Stegosaurs, among them the *Nodosauridæ*, quadrupedal forms heavy dermal armor."

These quotations show that the marine, fresh-water and terrestrial fauna, fishes, plesiosaurs, as well as stegosaurs were all included by Marsh in the Laramie fauna of the "Ceratops Beds" in general, which name, in fact, he assigned from the Montana type, *Ceratops montanus*. The eastern Wyoming (Converse county, where the great collection of *Triceratops* skulls was made by Hatcher), the western Wyoming (Bitter Creek) Laramie (where *Agathaumas*, Cope, was found), the Colorado (Denver beds, where *Polyonax*, Cope and *Ceratops alticornis* were found), and the Montana (Judith River and supposed Fort Union), are all treated by this author as of the same age, namely, Upper Cretaceous.

The confusion has been rendered greater in the early references of some of the Montana fossils to the *Fort Union beds*. A year after Cope's original description of his "Fort Union" collection he transferred them to the Judith River, in his paper on the "Geology of the Judith River beds." The Ft. Union beds have been considered late Cretaceous or on the border land between Cretaceous and Tertiary. In 1874-5, G. M. Dawson published several papers expressing the opinion that they are Eocene. L. F. Ward referred the Ft. Union beds to the Upper Laramie, from its flora; on the same ground Newberry placed it above the Laramie in the Tertiary. Quite recently Mr. Earl Douglas has made the very fortunate discovery in these beds of basal Eocene mammals of Puerco (Thanetien Montien) age. The reference of Montana dinosaurs to Fort Union beds is, therefore, an error.

It remains to be determined, therefore, whether all the fossils recorded from Montana are actually from Judith River beds, or whether a portion at least of the beds described and collected in as "Judith River" are not older than the Laramie.

PROVISIONAL CORRELATION

Fresh-water	Paskapoo[1]. (No dinosaurs)	Ft. Union[2].	
Brackish & fresh-water	Edmonton.	Laramie & Judith River.	Triceratops, Torosaurus, Dryptosaurus, Ornithomimus.
Marine	Pierre-Fox Hills group.	Fox Hills, Fort Pierre.	
Fresh and brackish-water	Belly River.	Montana exposures in part.	Stereocephalus, Monoclonius.
Sandy clays and sandstones.	910 feet.	(Niobrara).	Ceratops, Trachodon, Deinodon, Ornithomimus, Compsemys, Ptilodus.
	Ft. Benton.	Ft. Benton. Dakota.	

[1]. Regarded by Tyrrell as the beginning of the Tertiary.

[2]. Mammals of Puerco type discovered by Douglas in 1901.

2. Faunal Characters.

The Belly River or Mid-Cretaceous fauna is distinguished from that of the Upper Jurassic (Como Beds, Purbeckien) by the entire absence of Sauropoda and by the presence of Ceratopsia in great variety. It is affiliated with that of the Jurassic, and so far as we know separated from that of the Laramie by the presence of highly specialized Stegosauria or plated dinosaurs,* by numerous turtles of the Jurassic family *Pleurosternidæ*, and by numerous large Plesiosaurs.

Summarizing the table and with allowance for the provisional character of many of the determinations and of our incomplete faunal list, it appears that the (i) Belly River, (ii) Judith River and other beds erroneously referred to "Fort Union" of Montana, (iii) Laramie of Wyoming and Colorado are related as follows:

	Total number of species named.	Common to Belly River and Montana.	Common to Judith River and Laramie.
Fishes	8	3 species	
Batrachia	5	1 "	
Plesiosauria	4		
Testudinata	15	5 "	1 species.
Rhynchocephalia	4		
Lacertilia	5	2 "	
Ophidia	1		
Crocodilia	2	2 "	
Megalosauria	17	2 genera.	2 genera.
? Stegosauria	5	1 genus.	? 1 genus.
Iguanodontia	16	1 "	? 1 "
Ceratopsia	29	1 "	

It should be clearly stated that our knowledge is so inaccurate as to rob this comparison of much permanent value.

There is thus very little in common between the Belly River fauna and the Laramie fauna of Wyoming and Colorado so far as described, except the dinosaur *Ornithomimus* and the very persistent chelonian *Baëna*. Most of the dinosaurs will probably be found to be separated generically.

On the other hand, so far as known, the Montana fauna has much in common with the Belly River, especially among the Testudinata, Iguanodontia and Ceratopsia.

In the following table, which has been compiled with the aid of Mr. Lambe and Dr. O. P. Hay, the geological and geographical references are those given by the authors. Leidy's early references to the "lignite of Nebraska" are to territory now included in Dakota and Montana. In the second column are animals specified as in "Judith River beds"; in the third those entered as "Fort Union" or Laramie of Montana, largely Judith River no

* The only published evidence of Stegosauria in the Laramie of Wyoming and Colorado is the tooth of *Palæoscincus*.

doubt. In the fourth column, the Moreau River region of Dakota. In the fifth, Wyoming, Converse co. and Bitter Creek. In the sixth, the Colorado Laramie. In the seventh, the Edmonton beds of Alberta, which correspond with the true Laramie.

3. Distribution of Land and Fresh-water Cretaceous Vertebrates in the West *

Omitting Laramie Mammals

Species.	Belly River.	Judith River.	Montana.	Dakota (Nebraska).	Wyoming (Converse county).	Colorado (Denver Basin).	Edmonton (Alberta).	Incertae Sedis.
Pisces.								
Myledaphus bipartitus, Cope	*	X	*					
Mylognathus priscus, Leidy			*	N.D.K				
Hedronchus sternbergi, Cope		X	*					
Ceratodus hieroglyphus, "		X	*					
Acipenser albertensis, Lambe	*							
Lepidotus (Lepidosteus) occidentalis, Leidy	*	*				D		
Rhineastes (Ceratodus) eruciferus, Cope, sp.	*	X	*					
Diphyodus longirostris, Lambe	*							
Batrachia.								
Scapherpeton tectum, Cope	*	*						
" *laticolle*, "		*						
" *excisum*, "		*						
" *favosum*, "		*						
Hemitrypus jordaniamus, Cope		*						
Reptilia.								
Plesiosauria.								
Cimoliasaurus magnus, Leidy	*			Moreau R.				
Nothosaurops occiduus, "				*				
Ischyrosaurus antiquus, "				Moreau R. *				
Uronautes cetiformis, Cope		?						

* This table, subject to future revision, is of the nature of an author's list and includes all species named.

Species.	Belly River.	Judith River.	Montana.	Dakota (Nebraska.	Wyoming (Converse county).	Colorado (Denver Basin.	Edmonton (Alberta).	Incertæ Sedis.
Chelonia.								
Trionyx foveatus, Leidy	*	*				I.		
" *vagans*, Cope	*		B. Horn R. *	N. Dak.		* N.E. Col.		
Plastomenus (Trionyx) coalescens, Cope								
Plastomenus costatus, Cope								
" *punctulatus*, Cope						N.E. Col.		
" *insignis*, Cope						N.E. Col.		
Adocus lineolatus, Cope	*		B. Horn R. *			N.E. Col.		
Adocus (Basilemys, Hay) *variolosus*, Cope, sp	*							
Compsemys imbricarius, Cope		X						
" *victus*, Leidy			*	N. Dak.		D. N.E. Col.		
" *obscurus*, Leidy								
Polythorax missuriensis, Cope		X						
Baëna hatcheri, Hay	*				*			
" *antiqua*, Lambe	*							
Neurankylus eximius, Lambe	*							
Rhynchocephalia.								
Champsosaurus, profundus, Cope		*						
" *annectens*, "	*	*						
" *brevicollis*, "		*						
" *vaccinsulensis*, Cope		*						
Lacertilia & Incertæ Sedis.								
Iguanavus teres, Marsh					*			
Troödon formosus, Leidy	*	*						
Paronychodon lacustris, Cope		X						
Zapsalis abradens, Cope		X						
Chamops segnis, Marsh					*			

Species.	Belly River.	Judith River.	Montana.	Dakota (Nebraska).	Wyoming (Converse county).	Colorado (Denver Basin).	Edmonton (Alberta).	Incertæ Sedis.
Ophidia.								
Coniophis precedens, Marsh					*			
Crocodilia.								
Crocodilus humilis, Leidy	*	*				L.		
Bottosaurus perrugosus, Cope	*					* N.S.		
Megalosauria : Theropoda.								
Deinodon horridus, Leidy	*	*						
" (*Aublysodon*) *lateralis*, Cope		×						
" (*Lælaps*) *incrassatus*, "		×					*	
" *explanatus*, Cope	*	×						
" *falculus*, "		×						
" *hazenianus*, "		*						
" *cristatus*, "		×						
" *lævifrons*, "		×						
Ornithomimidæ.								
Aublysodon ~~*mirandus*, Leidy~~	*	*						
" *cristatus*, Marsh		×						
" *amplus*, "		×						
Ornithomimus velox, "						* D.		
" *tenuis*, "		×						
" *grandis*, "		×						
" *sedens*, "					*			
" *minutus*, "					*			
" *altus*, Lambe	*							
Stegosauria.								
Palæoscincus costatus, Leidy	*	*						
" *latus*, Marsh					*			
" *asper*, Lambe	*							

Species.	Belly River.	Judith River.	Montana.	Dakota (Nebraska).	Wyoming (Converse county).	Colorado (Denver Basin).	Edmonton (Alberta).	Incertæ Sedis.
Stegosauria—Con.								
Nodosaurus textilis, Marsh.								
Stereocephalus tutus, Lambe	*							
Ceratopsia.								
Agathaumas sylvestre, Cope								
Polponax mortuarius, "								
Dysganus encaustus "								
" *haydenianus* "								
" *bicarinatus*, "								
" *peiganus*, "								
Monoclonius crassus, "								
" *recurvicornis*, "								
" *sphenocerus*, "								
" *fissus*, "								
" *dawsoni*, Lambe	*							
" *canadensis* "	*							
" *belli*, "	*							
Ceratops montanus, Marsh.								
" *alticornis* "								
Triceratops horridus, "					*			
" *serratus* "					*			
" *prorsus*, "					*			
" *sulcatus*, "					*			
" *elatus*, "					*			
" *calicornis*, Marsh					*			
" *galeus*, "								
" *obtusus*, "					*			
Sterrholophus flabellatus, "					*			
Torosaurus latus, "					*			

Species.	Belly River.	Judith River.	Montana.	Dakota (Nebraska).	Wyoming (Converse county).	Colorado (Denver Basin).	Edmonton (Alberta).	Incertæ Sedis.
Ceratopsia—Con.								
Torosaurus gladius, Marsh					*			
Manospondylus gigas, Cope			*					
*Claorhynchus** *trihedrus*, Cope			*					
Stegoceras validus, Lambe	*							
Iguanodontia: Ornithopoda.								
Trachodon mirabilis, Leidy		*						
Thespesius occidentalis, "			†	S. Dak.				
Cionodon arctatus, Cope						N. & Col. *		
" *stenopsis*, "	*							Wood. Mt. B.
Diclonius pentagonus, Cope		×	†					
" *perangulatus*, "		×	†					
" *calamarius*, "		×	†					
Trachodon breviceps, Marsh		Cow Sel. ×	†					
" *paucidens* "		×	†					
Pteropelyx grallipes, Cope		×	†					
Trachodon longiceps, Marsh					*			
Claosaurus agilis,** "								
" *annectens*, "					*	D. & A.		
Trachodon (Pteropelyx) selwyni, Lambe	*							
" " *marginatus*, "	*							
" " *altidens*, "	*							
Aves.								
Cimolopteryx rarus, Marsh					*			
" *retusus*, "					*			
Mammalia.								
Ptilodus primævus, Lambe	*							
Boreodon matutinus, "	*							

*This may be an iguanodont.
**The type of the genus *Claosaurus* is from the Mid-Cretaceous, Pteranodon beds.

4. General Relations of the Fauna. *

FISHES.

The fishes include truly marine as well as brackish and fresh-water types, and are all of Montana and Alberta reference.

Myledaphus and *Mylognathus*, are marine sharks, supposedly related to the modern Chimæroids (Holocephala) ; *Hedronchus sternbergi* ("Fort Union," Montana) is similarly referred by Dr. Hay, although with much doubt. Two species of Dipnoans, *Ceratodus hieroglyphus* and *C.* (*Rhineastes*) *eruciferus* are also from the Montana and Belly River beds. The sturgeons are somewhat doubtfully represented in the new species *Acipenser albertensis* from the Belly River ; this may prove to be nearer *Lepidosteus*, a genus which is certainly represented in the *Lepidotus occidentalis* of Leidy, (Judith and Belly River).

The relationships of the new genus and species *Diphyodus longirostris* are entirely problematical.

BATRACHIA.

Cope has described five species of batrachia, all from the Judith River beds, belonging to the two Urodele genera *Scapherpeton* and *Hemitrypus*, of doubtful family relationship. One species *S. tectum* has been determined by Mr. Lambe in the Belly River.

No batrachians are recorded from the Wyoming Laramie.

REPTILIA.

Plesiosaurs. Numerous vertebræ of a large plesiosaur from the Belly River are provisionally referred to the New Jersey species *Cimoliasaurus magnus*, Leidy. From Moreau river, South Dakota, Leidy has described two Plesiosaurs, *Nothosaurops occiduus* and *Ischyrosaurus antiquus* ; whether these beds are of Belly River age or more recent is not known. *Uronautes cetiformis*, Cope is another plesiosaur from the Judith River.

Chelonia. Turtles of the sub-order *Trionychia* are abundant. One species, *Trionyx foveatus*, is common to the Judith and Belly River series ; another, *T. vagans*, to the Belly River and supposed "Ft. Union" beds.

Three other species, *Plastomenus costatus*, *P. coalescens* and *P. punctulatus* have been named by Cope, the first two from the Laramie of the "bad lands" south of Wood Mountain, Assiniboia, the third from the supposed "Ft. Union" (Judith River) of Montana. Dr. Hay observes that it is not unlikely that *P. coalescens* is a synonym of *Trionyx vagans* ; *P. costatus* and *P. punctulatus* are also more likely to belong to *Trionyx*. *Plastomenus* is distinctively an Eocene genus.

The order Cryptodira is represented by large swamp turtles related to the *Dermatemydidæ*, but belonging to the family *Adocidæ* ; these are *Adocus lineolatus*, Cope, *A.* (*Basilemys* or "royal turtle", Hay) *variolosus*, and *A.* (*Basilemys*) *imbricarius* ; the royal turtle is very large and elaborately sculptured. It is important to note that the two species first named are found both in the Belly River and in Montana (? "Ft. Union"), testifying to the Mid-Cretaceous age of the latter. The presence of numerous species of the Jurassic

*The writer is especially indebted to Dr. O.P. Hay of The American Museum for valuable notes, criticisms and suggestions on the systematic section of this introduction.

amily *Pleurosternidæ* (order PLEURODIRA or AMPHICHELYDIA) is another distinctively ancient feature of this fauna; two of these, *Compsemys victus* and *C. obscurus*, Leidy, are described from Montana. A third member of the same family, *Baëna hatcheri*, is noteworthy as the only species of vertebrate thus far recorded which is common to both the Belly River and Laramie. A fourth new species, *B. antiqua* is described from the Belly River. *Polythorax missuriensis* from Montana is also referred by Hay to the *Pleurosternidæ*. Mr. Lambe proposes the new genus and species *Neurankylus eximius*, a new chelydroid turtle, distinguished by a supernumerary costal.

RHYNCHOCEPHALIA. *Champsosaurus* according to Cope is represented by five species in the Judith River, one of which, *C. annectens* is also determined in the Belly River. As Cope has identified this genus in the basal Eocene, it is not distinctive as to age.

LACERTILIA or STEGOSAURIA. The sculptured tooth named *Troödon formosus* by Leidy is common to the Belly River and Judith River beds; it is uncertain whether this is a lizard or a stegosaur, probably the former. *Palæoscincus costatus*, Leidy, is also common to the Judith and Belly River series. A clearly distinct species is *P. asper*, Lambe, from the Belly River. It is important to determine definitely whether these animals are Lacertilia or Stegosauria.

Another sculptured tooth, *Iguanavus teres*, is described by Marsh from the Laramie and referred to the *Iguanidæ*. The same author has named *Palæoscincus latus* from the Laramie, and placed *Palæoscincus* among the Stegosauria.

CROCODILIA. The species *Crocodilus humilus* of the Judith River is provisionally identified by Mr. Lambe in the Belly River. These beds also contain another Montana crocodile, *Bottosaurus perrugosus*, Cope.

DINOSAURIA: STEGOSAURIA. As stated above, the presence of *Stegosauria* is an ancient characteristic. Marsh (op. cit., p. 242) has referred the genus *Palæoscincus* to this order. From the "Middle Cretaceous of Wyoming", Marsh determined the Stegosaur *Nodosaurus* (op. cit., p. 225).

Probably allied to this is the remarkable animal, *Stereocephalus tutus*, discovered by Mr. Lambe in the Belly River series, with solid skull armature and a ring of postcranial pointed ossicles.

No evidence of Stegosauria, with the possible exception of *Palæoscincus*, has been recorded from the Wyoming Laramie, Upper Cretaceous.

DINOSAURIA: (THEROPODA) MEGALOSAURIA, family *Megalosauridæ*. The carnivorous dinosaurs and their collateral families will probably be greatly elucidated by the separation of the Mid- from the Upper Cretaceous types. Among the former the genera *Deinodon* and *Aublysodon*, Leidy and *Ornithomimus*, Marsh, all Montana types, deserve first mention.

After Marsh had substituted the name *Dryptosaurus* for the preoccupied name *Lælaps* (which Cope had employed for an Upper Cretaceous of New Jersey Carnivore) it was generally supposed that all large Cretaceous carnivores should be referred to Marsh's genus. If, however, the large Judith River type, which has its counterpart in the Belly River, is Mid-Cretaceous, it is in all probability generically distinct and Leidy's name

Deinodon should be applied to it.* This name was securely founded on megalosaurian teeth, and those first mentioned in both Leidy's descriptions and first figured in his memoir on the Judith River vertebrates must be regarded as valid types irrespective of the following facts: (1) that Leidy expressed some uncertainty as to his separation of *Deinodon* from the Jurassic genus *Megalosaurus*, (2) that he associated with the types a number of large serrate incisor teeth, truncate posteriorly, which probably belong with *Deinodon*, (3) also smaller non-serrate teeth, also truncate posteriorly, which certainly do not belong with Deinodon, (4) that he subsequently selected the two latter (2 and 3) as the types of *Aublysodon*.

The Cretaceous carnivorous dinosaur of the Judith River beds should, therefore, be named *Deinodon*. Belonging to this is the type species *D. horridus*, Leidy; probably also the species *D. cristatus*, Cope and *D. lævifrons*, Cope, from Montana. To *Dryptosaurus*, on the other hand, belongs the large Upper Cretaceous carnivore *D. incrassatus*, Cope, from the Edmonton series of Alberta.

Family *Ornithomimidæ*. Mr. Lambe's discovery of additional remains of *Ornithomimus* in the Belly River series, as represented by a very large new species, is of great interest. Mr. Hatcher states that he found Marsh's type of this genus, consisting of a foot and a portion of a limb, on Cow island, Missouri river, at a level which he estimates from 1500 to 1600 feet below the summit of the Judith River beds, and 500 to 600 feet below the level of Marsh's type of *Ceratops montanus*.

Ornithomimus altus is probably a successor of a comparatively small and lightly built dinosaur recently discovered by the American Museum parties in the Como beds of Wyoming.** This Upper Jurassic animal measures 7 feet 4 inches from the tip of its premaxillaries to the tip of its tail. Estimated by the comparative size of its metapodials the Mid-Cretaceous *O. altus* was 22 feet in length with an extremely long and slender tail. The entire absence of vertical spines or neurapophyses in the mid-portion of the tail indicates that it was exclusively terrestrial in its habits and adapted to very rapid running. The resemblance to its Jurassic ancestor is especially striking in the greatly elongated zygapophyses of the caudal vertebræ which replace the neural spines and in the lateral compression of the terminal phalanges of the manus. *Ornithomimus* is more progressive than its supposed ancestor, in the development of cursorial rather than prehensile phalanges in the pes, these elements having nearly lost the recurved megalosauroid structure.

The teeth of this genus are not known; but comparison with its Jurassic prototype gives ground for believing, as suggested by Mr. Lambe, that the smaller teeth described by Leidy as *Aublysodon* may belong in the anterior part of the jaw; this genus, however, is by some considered invalid because based in part upon teeth belonging properly to *Deinodon*.

Dinosauria: (Ornithopoda) Iguanodontia. One of the distinguishing features of the Belly River fauna is the great number and variety of the Iguanodonts. Of the

* Dr. O. P. Hay (Amer. Geologist, xxiv, 1899, p. 346) is of the opinion that Cope was justified in rejecting the name *Deinodon*.

** It will shortly be described by the present writer in a bulletin of the American Museum.

generic * types of these animals *Trachodon mirabilis*, Leidy (1856) is Judith River; *Thespesius occidentalis*, Leidy (1856) is from "essentially the same horizon" (Hatcher) in Montana-*Claosaurus agilis*, Marsh (1872) is from the Mid-Cretaceous, Pteranodon beds (Colorado series, probably more nearly equivalent to Belly River); *Cionodon*, Cope (1874), Colorado; *Diclonius*, Cope (1876); *Pteropelyx*, Cope (1889) from Cow island, 40 miles below the mouth of the Judith river, (Hatcher) Montana; finally *Claorhynchus*, Cope (1892) regarded by this author as one of the *Agathaumidæ*, by Hatcher (op. cit., p. 382) as an iguanodont.

Of undoubted Upper Cretaceous age is *Hadrosaurus foulkii*, Leidy (New Jersey).

The separation of Mid- from Upper Cretaceous iguanodonts will, if confirmed by closer examination and determination of geological horizons and levels, greatly increase our understanding of this most interesting group. Without professing to have made an adequate investigation, the writer is strongly of the opinion that the Cretaceous includes a number of distinct genera, representing a wide adaptive radiation and probably a number of successively parallel phyla. The wide differences in the mode of succession, general shape and border sculpturing of the teeth, indicate profound changes which required an enormous period of time for their development.

In the Belly River series we find the new species *Trachodon selwyni*, Lambe, an animal nearly double the size of the *Iguanodon mantelli* of the English Wealden (Upper Jurassic). A more delicately built iguanodont, *P. marginatus*, Lambe, resembles the less robust iguanodont *Pteropelyx grallipes*, Cope, but is specifically distinct in the border sculpture of the teeth. A third new species, or even genus *P.* (*Didanodon*) *altidens*, Lambe, distinguished by exceptionally high narrow teeth.

There are therefore indications of a separation of the Iguanodonts into light and heavy limbed series, smaller and larger, swifter and clumsier, of great variety in tooth structure.

Dinosauria: Ceratopsia. In this order, perhaps more than in any other, the resemblance between the Belly River and Montana stages and the contrast between these and the Wyoming Laramie stages, so far as known, are distinctly marked.

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* Mr. J. B. Hatcher has just published (Annals of the Carnegie Museum, 1902. Vol. I, Art. XIV. p. 377) a systematic review of these animals: "The Genera and Species of the Trachodontidæ (Hadrosauridæ, Claosauridæ), Marsh." He reaches the conclusion: "A careful examination of the original descriptions and figures of the types of the ten genera and twenty species enumerated above, shows that there should be a great reduction in each and that the ten genera which have been proposed should be reduced to two *Trachodon*, Leidy, and *Claosaurus*, Marsh, while the remaining eight genera should be treated as synonyms of Trachodon, which should also be made to include *T.* (*Claosaurus*) *annectens*, Marsh; while the smaller *Claosaurus agilis* described by Marsh from the Kansas chalks may still be considered as pertaining to a distinct genus . . . . . Doubtless many of the species are also synonyms but this can only be determined by a careful comparison of the types."

The type genera are distributed geographically as follows :—

Montana.	Wyoming Laramie.	Wyoming, Converse co. Laramie.	Colorado.
Monoclonius, Cope.	Agathaumas, Cope.	Triceratops, Marsh.	Polyonax, Cope.
Dysganus, "	(Cretaceous No. 6 or 7.)	Torosaurus, "	
Ceratops, Marsh.		Sterrholophus, "	
Claorhynchus[1], Cope.			
Manospondylus, "			

[1] So referred by Cope. Considered by an iguanodont by Hatcher.

In general the contrast in the Ceratopsia is as follows; future discovery may alter these prevailing characters :—

Belly & Judith River Ceratopsia.	Laramie Ceratopsia, Upper Cretaceous.
Of smaller size.	Of larger size.
Nasal horns very large.	Nasal horns relatively smaller (Triceratops) or even vestigial.
Small frontal or supraorbital horns.	Greatly developed frontal horns.
Widely open supratemporal fossæ.	Supratemporal fossæ open (Torosaurus) or nearly closed (Triceratops).
Teeth single (*? Monoclonius*) and double fanged.	

Monoclonius is the first name applied to a Montana ceratopsid. The type species, *M. crassus*, Cope, is distinguished by small supraorbital horns, a large supratemporal fossa, and a wide squamoso-parietal crest. *M. recurvicornis*, Cope, is distinguished by a forwardly recurved nasal horn; *M. sphenoceras*, Cope, by a remarkably elongate and laterally compressed nasal horn; *M. fissus*, Cope, by a squamosal of peculiar form.* *Ceratops montanus*, the first of the horned dinosaurs described by Marsh, was found on the Missouri river, Montana, in beds which Mr. Hatcher now considers of Judith River age. It is very similar to if not generically identical with *Monoclonius*. If this prove to be the case, Cope's suggestion (op. cit. p. 715) that this family should be called *Agathaumidæ*, rather than *Ceratopsidæ* will deserve consideration. The apparently new species *M. dawsoni*, *M. canadensis*, and *M. belli*, discovered by Mr. Lambe in the Belly River series, add to the variations in the *Monoclonius* type of skull in the Mid-Cretaceous.

It will be observed that five of these species are known to possess large nasal and small supraorbital horns. This stage of horn evolution *may* be contemporaneous with and independent of that in the southern Laramie dinosaurs in which the nasal horns are

* For the latest account of these types, which are now preserved in the American Museum of Natural History, see Cope, "The Horned Dinosauria of the Laramie", *Amer Nat.* 1889, p. 715.

invariably smaller than the frontal horns, but coupled with the smaller size and open temporal fossæ, it would appear to be more primitive.

The new genus *Stegoceras*, proposed in this memoir, may represent a type with small nasal horns, as in some of the Laramie Ceratopsids, such as *Sterrholophus*.

It is not at all improbable that the horned dinosaurs will prove to be diphyletic, one line with persistent open fossæ leading from *Monoclonius* to *Torosaurus*, the other leading to *Triceratops* with closed fossæ.

MAMMALIA.

Of the two Mammals discovered in the Belly River, *Ptilodus primævus*, judging by the condition of the grooves upon its premolars and tubercles upon its molar teeth, is undoubtedly more primitive than the Laramie plagiaulacids.

5. General Conclusion.

The conclusion is that the Belly River fauna is more ancient in character both as to the older types of animals which it contains and as to the stages of evolution among animals which are also represented in the Laramie. The geological interval represented by the Ft. Pierre-Fox Hills marine beds was accompanied by the extinction of certain Jurassic types and progressive evolution of the persistent types. Finally the fossil vertebrates hitherto described from Montana probably are, in part at least, of Mid-Cretaceous or Belly River age.

American Museum of Natural History,
July 25, 1902.

GEOLOGICAL SURVEY OF CANADA.

2—NEW GENERA AND SPECIES FROM THE BELLY RIVER SERIES (MID-CRETACEOUS).

BY

LAWRENCE M. LAMBE.

Views in the valley of Red Deer River, Alberta, below the mouth of Berry Creek.

GEOLOGICAL SURVEY OF CANADA

2—NEW GENERA AND SPECIES FROM THE BELLY RIVER SERIES (MID-CRETACEOUS).

By Lawrence M. Lambe.

The present report consists of descriptions or determinations of vertebrate remains, from the Belly River series of the Cretaceous, collected by the writer during the summers of 1897, 1898 and 1901 in the Red Deer river district.

The species represented in these collections belong for the most part to the class Reptilia.

In 1897, the writer descended Red Deer river, starting from the village of Red Deer, and made collections from the Edmonton subdivision of the Laramie, between Red Deer village and Willow creek, and from the Belly River series between Bull Pound creek and Dead Lodge cañon.

The results of this expedition fully realized the belief of Dr. George M. Dawson, Director of the Geological Survey, that a systematic collection of the dinosaurian and other reptilian remains, that were known to occur abundantly and in an excellent state of preservation in the rocks of the Edmonton and Belly River series in the vicinity of Red Deer river would prove to be of scientific value and interest.

In this year, however, it was found that the best results were obtained in the Belly River series, in the vicinity of Berry creek. Accordingly this locality was revisited in 1898, and again in 1901, and collections made from the Belly River series only, in an extensive area of "bad lands" on either side of Red Deer river between Berry creek and Dead Lodge cañon.

To Dr. G. M. Dawson, Mr. R. G. McConnell and Mr. J. B. Tyrrell principally, belongs the credit of having elucidated the geology of the Cretaceous and Laramie rocks in the region extending from Milk river on the south to north of Red Deer river, in which region the Belly River series has an extensive development, its boundary having been traced for over 150 miles in underlying contact with the Pierre-Fox Hills group, with abundant and conclusive proof of the subordinate position of the former to the latter.

Mr. J. B. Tyrrell, in his report on the geology of northern Alberta,* divided the rocks of Laramie age, overlying the marine Pierre-Fox Hills group, into a lower and a

* Geological and Natural History Survey of Canada, Annual Report, new series, vol. II., part E. 1886.

higher subdivision, which he called respectively the Edmonton and the Paskapoo series. The Edmonton series he regarded as closing Cretaceous times, the Paskapoo rocks he considered as the representatives of the beginning of the Tertiary epoch. The Paskapoo series is a fresh-water deposit, the Edmonton series is of brackish-water origin.

Of the Belly River series Dr. Dawson writes* :—" in the region of the Bow and Belly rivers, the Pierre is underlaid by an extensive fresh and brackish-water series, consisting of sandy argillites and sandstones ; the upper portion is characteristically pale in tint, the lower generally darker and yellowish or brownish. This has been called the Belly River series, and appears to correspond precisely to that occupying a similar stratigraphical position on the Peace river, and there designated the Dunvegan series. These indicate the existence of a prolonged interval in the western Cretaceous area, during which the sea was more or less excluded from the region, and its place occupied for long periods by lagoons or fresh-water lakes. Below these, both in the region of the Bow and Belly and on the Peace rivers, is a second series of dark shales which may probably represent the Benton group of the Missouri sections."

The approximate maximum ascertained thickness of the series, according to Dr. Dawson, † is 910 feet.

The same authority, in describing these rocks, remarks,‡ that "the separation of the lower, or yellowish and banded portion of the Belly River series," from the upper or pale part, "is made merely for convenience of description, and is probably not warranted in any other sense. The distinctive characters of the two portions of the series are indeed so indefinite that though little hesitation might be felt in relegating a given large exposure to one or other, the points of difference vanish when any attempt to draw a precise line is made."

The following section, as seen on Fossil coulée, in the Milk river district is regarded by Dr. Dawson ‖ as a representative one of the upper or pale part of the series ; the beds in descending order are :—

	Feet.	Inches.
Dark gray, soft, sandy clay	6	0
Yellowish sand or soft sandstone	4	0
Gray, soft sands, with some bands of clay	15	0
Gray, soft sandstone	1	0
Greenish-gray clay	5	0
Gray, soft, shaly sandstone	1	0
Gray, soft, sand and sandy clay	4	0
Greenish-gray clay	5	0
Nodular layer of impure calcareous ironstone	1	6
Yellowish, fine sand, or soft sandstone	4	6
Dark gray, sandy clay	3	6
Greenish-gray sands, irregularly hardened and forming projecting cornice-like layers of sandstone	8	6
Greenish clay, with large impure septarian ironstone nodules	8	0

* Descriptive sketch of the Physical Geography and Geology of the Dominion of Canada by A.R.C. Selwyn and G. M. Dawson, 1884, p. 40.

†Report of Progress, Geol. and Nat. Hist. Survey of Canada. 1882-3-4, p. 112 c.

‡ Ibid, p. 117 c.

‖ Ibid, p. 50 c.

	Feet.	Inches.
Greenish-gray, sandy clays and clays	10	0
Yellowish-gray, sandy clay, with layer full of small clay pebbles at top	10	0
Yellowish-gray, fine, soft sand	3	0
Brown-weathering, shaly sandstone, becoming conglomeritic with small clay pebbles in some places (locally developed)	1	6
Gray, soft, fine sand	3	0
Gray, fine-grained sandstone	1	0
Pale greenish-gray clay, slightly banded	15	0
Pale greenish-gray, soft, sandy clay	4	6
Gray, soft, clayey sand. The upper portion full of small soft ironstone concretions	3	0
Gray, soft sandstone	0	2
Grayish, soft, clayey sand	5	0
	123	2

In the Red Deer river district the upper beds of the series are represented, with probably the upper part of the lower beds. They consist mainly of, from about 200 to 400 feet of alternating soft, light gray, clayey sandstones and grayish and dark clays with thin beds of ironstone and layers of ironstone nodules. Thick beds of yellowish sandstone also occur near the base. These yellowish sandstones appear to be at about the dividing line between the upper and lower portions of the series.

The Belly River series is correlated by Dr. Dawson* with the Judith River series of the Missouri.

One of the first reports, if not the first, to appear on reptilian remains from western Canada, was that of Professor E. D. Cope, which took the form of an appendix to Dr G. M. Dawson's " Report on the Geology and Resources of the forty-ninth parallel " issued in 1875. Professor Cope here described certain dinosaurian, cheloniau and fish remains from the " Fort Union group " of Milk river.

Since then, reference has been made, from time to time in the reports of the Geological Survey, to the discovery of reptilian remains in the Laramie and Belly River series, at various localities in the north-west. Unfortunately, the collecting of such remains has not been systematically undertaken and, except in one instance, no detailed report has appeared on the occasional remains of reptiles brought from the west, that exception being the description given by Professor Cope,† in 1892, of two skulls of *Lælaps incrassatus*, obtained in 1884 and 1889, by Mr. J. B. Tyrrell and Mr. T. C. Weston, respectively, on Red Deer river, from rocks of the Edmonton series.

One of the chief difficulties, encountered in studying the remains of the dinosaurs and other reptiles from the Red Deer river district, arises from the fact that the bones are generally very much scattered, separate bones of different species occurring together, the finding of a number of bones, of one individual, in their natural relative position to each other being rare.

As a rule the bones are well preserved but very fragile, so that the greatest care is requisite, and special precautions necessary, before their removal can be attempted.

* Report on the Geology and Resources of the forty-ninth parallel, 1875, p. 156, and Report of Progress, Geol. and Nat. Hist. Survey of Canada, 1882-3-4. p. 119 c.

†"On the skull of the Dinosaurian *Lælaps incrassatus*, Cope." Proc. Amer. Philos. Soc., vol. xxx, p. 240, 1892.

The writer wishes to acknowledge the assistance rendered to him, by Dr. O. P. Hay, of the American Museum of Natural History, who by the expression of his views regarding the affinities of some of the species of turtles represented in the collections, and by other courtesies, greatly facilitated the work connected with the determination and description of these interesting reptiles.

In 1901, Mr. L. Heber Cole, of Montreal, acted as assistant in the field, and contributed materially to the success of the expedition of that year.

The writer is particularly indebted to Professor Henry Fairfield Osborn, Curator of the Department of Vertebrate Palæontology of the American Museum of Natural History, New York, for his co-operation in the study of the structure, systematic relations and nomenclature, pursued partly in Ottawa, partly in the American Museum by comparison with the extensive Cope collection.

PISCES.

Myledaphus, Cope.

Myledaphus bipartitus, Cope.

Plate XIX, figs. 1 and 2.

Myledaphus bipartitus. Cope. 1876. Proc. Acad. Nat. Sci. Philadel., p. 260.

This species is represented by many teeth found separate in all cases. Their variation in size is considerable, the smallest measuring about 2·25 mm. on the longer diameter of the crown, whilst the largest collected has a diameter of 9 mm. in the same direction. The proportions of the majority of the specimens are nearly constant. Measurements taken from an average sized tooth almost coincide with those given by the author of the species in his original description. In the majority of the specimens the crown is irregularly striated in a direction at right angles to and on both sides of the line dividing it into halves although generally one half has fewer striations than the other. The crowns of some of the teeth are smoother than those of others, a difference due probably to age.

Measurements of an average sized tooth.

	M.
Length of tooth	·0055
Long diameter of crown	·0062
Short " " "	·0045
Length of root	·0030
Long diameter of root	·0042
Short " " "	·0030

Belly River series, Red Deer river, 1898 and 1901.

Dr. G. M. Dawson collected a number of specimens on Belly river, N.W.T. (Nos. 40 and 41), in 1881, and Mr. Weston specimens in Irvine coulée, near Irvine station on the line of the C.P.R., in 1888.

Cope, in describing this genus, was doubtful as to its affinities, but states "that the form of the root recalls the *Elasmobranchii*, and that of the crown some of the rays." The types he recorded as from the Fort Union beds of Montana.

Acipenser, Linnæus.

Acipenser, albertensis Sp. nov.

Plate XXI, fig. 9.

The strongly keeled and highly ornamented shield shown on plate XXI, apparently represents an ancient sturgeon, for which the above name is proposed. The ornamentation consists of rounded, coalescent ridges and nodes in high relief, and quite smooth, not very unlike the sculptured surface of the shell of some species of turtles.

This genus has not hitherto been known from rocks lower than the Tertiary.

Belly River series, Red Deer river, District of Alberta, 1901.

Lepidotus, Agassiz.

Lepidotus occidentalis, Leidy.

Plate XIX, fig. 3.

Lepidotus occidentalis, Leidy, 1860. Trans. Amer. Philos. Soc. Extinct Vertebrata from the Judith River and Great Lignite formations of Nebraska, pl. 11, figs. 20-23.

Numerous scales, from the "bad lands" of Red Deer river, are apparently not distinguishable from those described by Leidy under the name *Lepidotus occidentalis*.

The scale figured is fairly representative of those in the collections, as regards form and size. The lozenge-shaped, enamelled outer surface is smooth and shiny, with generally a few small, puncture or pit-like depressions scattered toward the centre; a few growth lines are generally observed parallel to its edge. Length of specimen figured 18·5 mm., greatest thickness 3·0 mm.

Belly River series, Red Deer river, 1898 and 1901.

Similar scales were collected by Dr. G. M. Dawson on Belly river, N.W.T. (Nos. 40 and 41), in 1881, and by Mr. T. C. Weston, at Ross coulée, near Irvine on the line of the C.P.R., in 1884.

Rhineastes, Cope.

Rhineastes eruciferus, Cope. (sp.)

Ceratodus eruciferus, Cope. 1876. Proc. Acad. Nat. Sci. Philadel., p. 259.

A number of fragments of cranial bones are referred to this species after comparison with the type from the "Fort Union" beds of Montana. The sculpture consists of strong

parallel or divergent ribs that, in places, frequently coalesce and are sometimes interrupted; when divergent, additional ribs are intercalated at intervals. Fragments of spines with parallel grooves and ridges, running in the direction of the length, are thought to belong to the same fish.

These remains resemble, somewhat, the corresponding parts of some of the species of *Rhineastes* described by Cope from the Tertiary of the western States, and are here assigned, at least provisionally, to that genus.

Belly River series, Red Deer river, 1901.

Diphyodus. Gen. nov.

Diphyodus longirostris. Sp. nov.

Plate XV., figs. 18 and 19.

The bone figured on the above plate affords evidence of the complete coalescence of the premaxillæ in a fish to form a long, slender, snout armed with teeth that succeeded each other in a regular alternating manner. These characters have suggested the names of the genus and species proposed.

The specimen is in the form of a comparatively thick plate bent, on itself, so as to be U-shaped in transverse section ; it is imperfect at both ends, is 23 mm. long, tapers slightly toward the front, and is 4 mm. broad posteriorly and 3·5 mm. broad at its anterior end. There is no evidence of a median longitudinal suture. The sides of the hollow semi-cylinder thus formed, are slightly over 1 mm. thick, but the thickness of the basal part is over 2 mm. On the flattened upper surface of the two sides, are preserved, circular bases of teeth, anchylosed to the bone, that appear as raised circles, averaging ·80 mm. in diameter and about 2 mm. apart from centre to centre. On the right side there are nine teeth represented at equal intervals, but on the left side, although there were a like number of teeth, the interspaces are not so regular. Shallow subquadrangular depressions, varying in number from one to three, according to the length of the interspace, occur between the tooth-bases. Each depression represents the former position of a tooth that has fallen out or has been broken off.

A circle of minute pits or foramina surrounds each tooth-base; similar but less regular pits occur in the intervening depresssions and a few are observed within the tooth-bases themselves. Two tubular canals, placed side by side, above the centre of the base, pierce the bone longitudinally throughout its length. The bottom of the median groove between the two rows of teeth has an undulating surface. The sides and rounded base of the bone are smooth and show irregular longitudinal lines of small pit-like markings. One of the tooth-bases at the posterior end is decidedly subquadrangular or oval in shape with its larger diameter transverse.

Two or three fragments present the same characteristics of structure.

Belly River series, Red Deer river, 1901.

BATRACHIA.

Scapherpeton, Cope.

Scapherpeton tectum, Cope.

Plate III, figs. 4–8.

Scapherpeton tectum, Cope. 1876. Proc. Acad. Nat. Sci. Philadel. vol. xxviii, p. 355.

This species is represented in the collection by a number of trunk vertebræ and atlases. Almost as many of the latter as of the former were obtained, a peculiarity that can be accounted for only by supposing that the stout, compact form of the atlas aided in saving it from breakage.

The trunk vertebræ, of which one of the best is figured, are biconcave, with well developed pre- and postzygapophyses. a backwardly directed, stout neural spine whose basal front extends forward as a prominent keel between the prezygapophyses. A number of foramina enter the spine in its upper half where it is seen to be hollow. The centrum is pinched or laterally compressed below, so as to produce a strong carination inferiorly, and an elongation of the articular cups downward. The notochord is not persistent; the foraminæ for its entry into the central body are conspicuous at the bottom of the articular cups. The diapophysis is directed outward and backward and has an irregular, figure 8 shaped, transverse section, as described by Cope. A foramen enters the base of the diapophysis from in front, another from behind and, on the right side of the vertebra figured, one also enters from below. In figure 4 the neural spine and the postzygapophyses are restored from a separate spine to the base of which the zygapophyses remain attached. In one of the larger vertebræ, the roof of the neural canal is angularly vaulted and the front border of the arch between the prezygapophyses is notched and turned slightly upward. Numerous small foramina occur in all parts of the vertebræ.

Three figures are given of one of the largest and best preserved atlases, to show the two facets for articulation with the occipital condyles of the skull, the anterior process projecting from the centrum between the two facets, and the articular cup behind. A number of foramina occur in the concave inferior surface of the atlas. Other foramina occur as depicted.

Measurements.

	M.
Of trunk vertebra:	
Length of centrum	·008
Height of articular cups	·006
Breadth of same	·004
Diameter of notochordal foramen	·001
Antero-posterior diameter of neural spine measured from between postzygapophyses	·0035
Of atlas:	
Extreme length	·007
Extreme breadth	·0095
Height of facets for articulation with condyles of skull	·003
Breadth of same	·004
Height of articular cup	·0037
Width of same	·003

Belly River series, Red Deer river, 1901.

The position of this genus was not definitely determined, but its author considered that the structure of a proximal limb bone, and the form of the diapophyses of the vertebræ referred it with much probability to the *Urodela*, and that the biconcave centra placed it nearest to the *Amblystomidæ*. Also that other structural points indicated a family different from any of those now living.

A small right maxilla of which, two views are given (plate XV, figs. 16 and 17) is of interest. It is almost perfect anteriorly. Its upper border comes to a sharp edge, from which posteriorly a small fragment has been broken off, as indicated in the figure. A ridge extends the length of the bone on the inner side at about mid-height at the centre but curving downward to near the lower margin in front. Posteriorly two sutural surfaces occur, one on the inner side in continuance of the ridge, the other emarginates the upper border. Between these two surfaces the bone is shallowly excavated. Six large foramina occur in a line at about mid-height in the anterior half of the outer surface. The lower border of the maxilla is broad and bears eight subquadrately elliptical tooth-bases with their greater diameters transverse to the length of the jaw. Small foraminal openings occur encircling the outer surface of the tooth-bases. Teeth have been lost from the jaw leaving shallowly depressed interspaces.

The relationship of this bone is not clearly understood, but it is for the present associated with *Scapherpeton tectum*. It occurred with and is of the same colour and texture as the vertebræ of that species.

REPTILIA.

SAUROPTERYGIA.

PLESIOSAURIDÆ.

Cimoliasaurus, Leidy.

Cimoliasaurus magnus, Leidy.

Cimoliasaurus magnus, Leidy. 1852. Proc. Acad. Nat. Sci. Philadel., vol. v, p. 325, and ibid, 1854 vol. vii, p. 72, pl. ii, figs. 4–6.

Cimoliasaurus magnus, Leidy. 1865. Cretaceous Reptiles of the United States, p. 25, pl. v, figs 13–19 and pl. vi, (Smithsonian Contr. to Knowledge, vol. xiv).

Fourteen cervical vertebræ, found within a limited space and probably belonging to one individual, are referred to this species ; they form a tolerably complete series with a gradual increase in size from front to back.

These vertebræ agree with those of the type species in form but are smaller.

The centra may be described as shorter than broad, with concave sides and lower surface, articular faces ellipsoidal, sligthly concave with angular margins, costal facet placed low on the sides. Neural arches in all the specimens, broken off, except in one, apparently a late cervical, in which the basal part on one side is preserved, showing the

height of the neural canal. The bases of the ribs still remain in a few cases. In the supposed late cervical, the costal facet extends upward on to the base of the neural arch. Two large foramina, placed one on either side of the median line of the lower surface and separated by a low ridge, are connected with a passage that opens into the neural canal by two separate apertures. The neural canal is about as high as it is wide.

Measurements.

	M.
A small vertebra from anterior end of series :	
Length of centrum	·045
Breadth of articular face	·065
Height of same	·040
Width of neural canal	·012
A larger vertebra from posterior end of series :	
Length of centrum	·044
Breadth of articular face	·072
Height of articular face	·045
Width of neural canal	·015
Height of costal face	·025
Breadth of same	·022

According to Cope, *Discosaurus* is specifically identical with this genus. Whilst under the generic name *Cimoliasaurus*, Lydekker* has included *Brimosaurus*, Leidy, and *Elasmosaurus* and *Polycotylus* of Cope.

Belly River series, Red Deer river, below Berry creek, 1898 and 1901.

CHELONIA.

TRIONYCHIDÆ.

TRIONYX, Geoffroy.

TRIONYX FOVEATUS, Leidy.

Plate I, figs. 1 and 2.

Trionyx foveatus, Leidy. 1860. Trans. Amer. Philos. Soc. vol. xi, p. 148, pl. xi, figs. 1 and 2.

" " Lambe. 1902. Geol. Survey of Canada, Summary Report for 1901, p. 81, pls. I and II.

Trionyx foveatus was originally described by Leidy from small fragments of costal and sternal bones from the Judith River beds of Nebraska.

A carapace, from the Belly River series of the Red Deer river district, lacks only the nuchal plate, which unfortunately was missing.

*Cat. of Foss. Reptilia and Amphibia, Brit. Mus., pt. II, p. 211, 1889.

This carapace (fig. 1) is a little broader than long, and is only slightly convex. Seen from above, its anterior, posterior and lateral curves are flattened so as to make the outline subquadrangular. The eight pairs of costals are entire and there are six neural

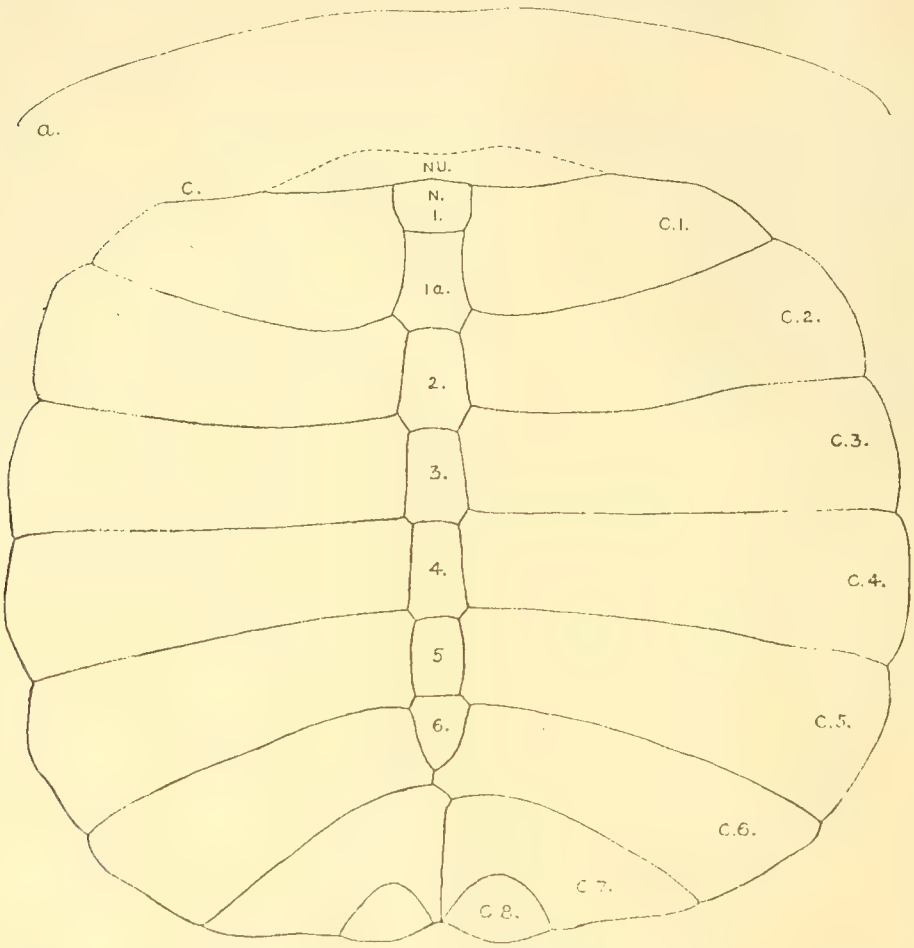


FIG. 1.—Carapace of *Trionyx foveatus*, from Red Deer river; *a*, outline of the transverse curve of its upper surface. Five-eighths the natural size. *NU*, Nuchal bone (restored); *N1*, *1a*, *2*, &c., Neural bones; *C1*. *2*. &c., Costal bones.

bones of which the anterior one is divided. Neural 1 is broader than long with convex sides, neural 1a is longer than broad, broadest near its posterior end and has concave sides. Neurals 2, 3 and 4 are six-sided, neural 5 is oblong, and neural 6, lying for the most part between the sixth costals, is shield-shaped, narrowing to a point behind. The seventh costals are suturally united at their inner ends, where they develop a breadth sufficient to separate the eighth costals from each other. These last are subtriangular in shape, with three convex sides. The nuchal plate was evidently small, as the lateral termination of the suture (c, in figure 1) between it and the first costal indicates a side extension not far past a point in advance of the mid-length of the first costal; its lateral ends lie beneath the front border of the first costals and are not seen from above.

Small, shallow, rounded depressions mark the surface of the neurals and the inner ends of the costals. In the latter, as the distance from the neurals increases, the depressions gradually grow larger and more decided, becoming often reniform or oval, and frequently coalescing, until in the distal ends of the costals a few more or less continuous furrows are formed parallel to the outer margins of the plates. These furrows are a conspicuous feature in the sculpture; they are not so well marked on the posterior margin of the carapace, but are well developed near the front edges of the first costals. In the neurals and inner halves of the costals there is a narrow, smooth strip, devoid of sculpture, bordering the sutures. The rib-heads are well developed.

Measurements.

	M.
Estimated length of carapace along median line ($6\frac{6}{10}$ inches)	·168
Length of carapace, along median line, from anterior edge of neural 1 to posterior margin	·163
Maximum breadth of carapace ($8\frac{4}{10}$ inches)	·214
Length of first neural (1 + 1a)	·033
Length of second neural	·023
Maximum breadth of second neural	·017
Thickness of fourth costal at centre near inner end	·005
Thickness of fourth costal at centre near outer end	·005
Thickness of eighth costal at centre	·005

The hyosternal and hyposternal bones of this species, shown in fig. 2, page 36, belong to individuals of larger size than the one represented by the carapace. The missing parts in fig. 2 are restored from a number of other specimens in the collection, of which no two are exactly alike. The sculpture differs considerably from that of the carapace and is shown on plate I, fig. 2.

Belly River series, Red Deer river, 1901; also numerous costal bones and fragments of the carapace with separate neural bones as well as hyoplastra and hypoplastra and bones of the endoskeleton, 1897, 1898 and 1901.

Dr. G. M. Dawson collected fragments of the carapace on Belly River, N. W. T. (Nos. 40 and 41) in 1881.

Trionyx planus,* Owen and Bell, a British Lower Eocene species, described from the posterior half of the carapace, bears a strong general resemblance to *T. foveatus* as regards the sculpture, and also in the absence of the seventh and eighth neurals, accompanied by a similar curtailment of the sixth neural.

* Monograph of the British Reptilia of the London Clay, part I, p. 58, tab. XIX c, 1849. Palæontographical Society.

The strong development of the seventh costals, found in the Red Deer river carapace, resulting in a reduction of the eighth pair of costals, is probably an irregularity of growth of no specific importance.

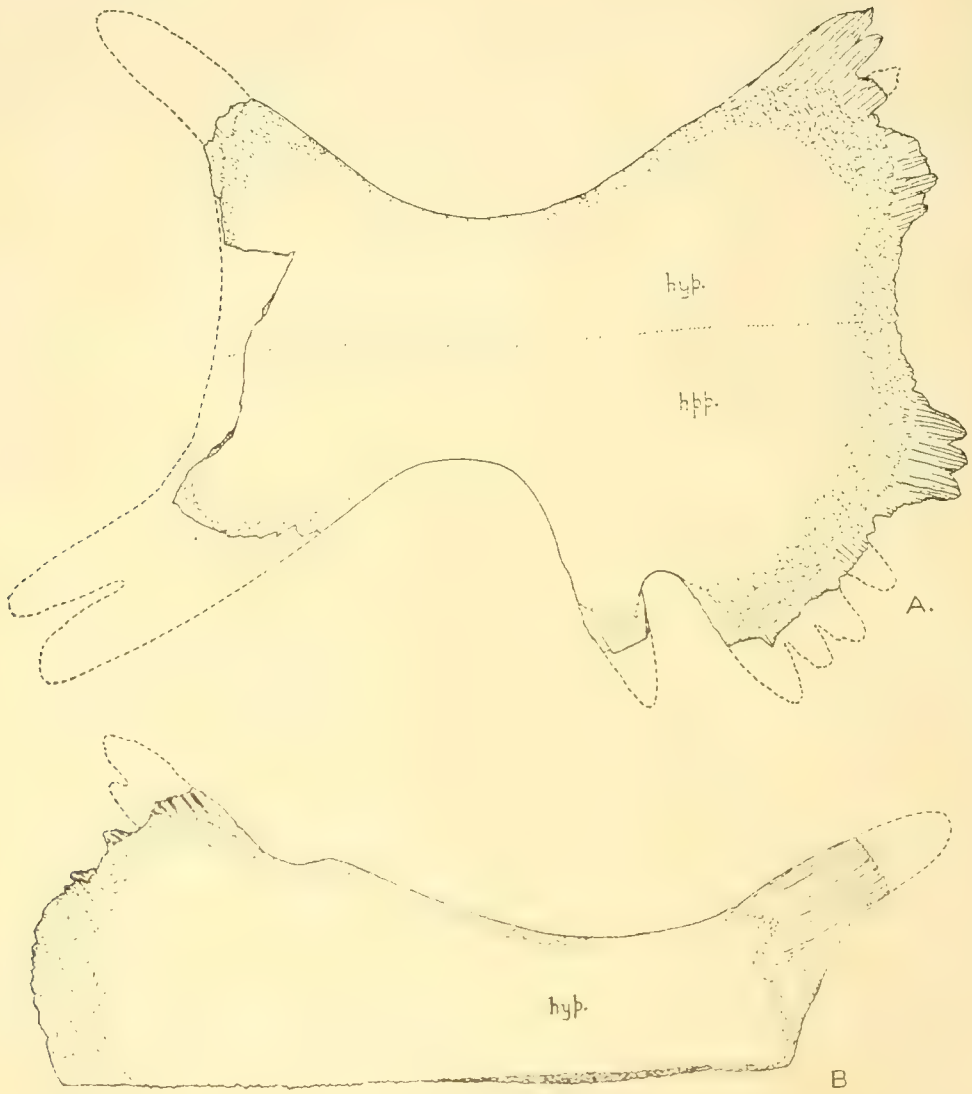


Fig. 2.—A, The lower or outer surface of the right hyoplastral and hypoplastral bones of *Trionyx foveatus*; B, the lower surface of a left hyoplastal. Natural size.

Trionyx vagans, Cope.

Plate I, figs. 3 and 4.

Trionyx vagans, Cope. 1874. Bull., U. S. Geol. Surv. Terrs., No. 2, p. 27; and 1875, Vertebrata of Cretaceous Formations of the West, p. 96, pl. vi, figs. 13 and 14.

Trionyx vagans, Lambe. 1902. Geol. Survey of Canada, Summary Report for 1901, p. 81, pls. iii and iv.

This species was first described from "a number of fragments of costal bones and perhaps of sternals also" from the "Lignite Cretaceous of Colorado; near the mouth of the Big Horn river, Montana; Long lake, Nebraska; found at the last two localities by Dr. Hayden." Later, in 1875, in "The Vertebrata of the Cretaceous Formations of the West" the same description appears; this time with figures of two fragments of costal bones.

A carapace (fig. 3) referable to this species, was obtained in 1901, from the Belly River series of Red Deer river below Berry creek.

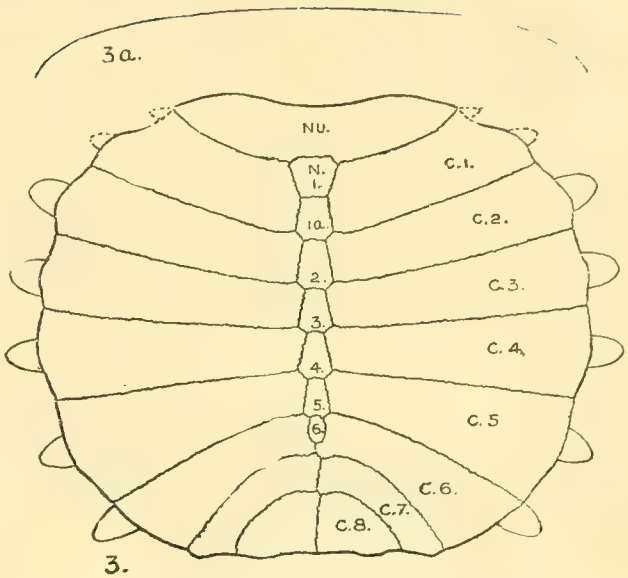


FIG. 3.—Carapace of *Trionyx vagans*, from Red Deer; *a*, out line of the traverse curve of its upper surface. One-eighth the natural size. Letters as in figure 1, page 34.

It is broader than long, the breadth exceeding the length by more than one-sixth, and is only moderately convex. In outline, as seen from above, it is flat behind with the sides curving broadly to the front margin, at the centre of which there is a shallow concavity. The shell protrudes where the ribs pass outward from beneath, causing the lateral margin to be sinuous, the sinuosity being most marked toward the front in the first, second and third pairs of costal plates. Of the eight pairs of costals, the first costals are the broadest at the inner ends, whilst the fifth are the broadest distally. The seventh costals are extremely narrow throughout their length and the eighth pair is well developed. The first costals increase in breadth rather suddenly at their outer ends and are separated by a divided first neural plate. The neurals gradually decrease in breadth to the fifth, their sides being not so nearly parallel to each other as those of the corresponding plates in *T. foveatus*. The sixth and last neural is very much reduced in size and is irregularly oval in outline. Of the protruding rib-ends, all the six of the left side were secured, in a fair state of preservation, except the one belonging to the first costal and it was obtained in part. The rib-heads are well developed. In the figure, the nuchal plate is represented as entire. Of the carapace under consideration, the central part only of the nuchal plate, extending from the margin in front to the suture behind, was found, but fortunately the left end of a nuchal, of another individual of similar size, showing the left front margin and the suture between the plate and the first costal with part of the latter adherent, supplied the deficiency. The sculpture consists of a network of narrow ridges, ramifying and inosculating so as to enclose small, sunken areæ of irregular shape and size, the areæ being generally wider than the ridges are broad. The frequent confluence of a varying number of areæ results in a more open pattern, the ridges at times showing a tendency to run in parallel lines. The sculpture is not so distinctly defined near the sides of the carapace as it is toward and at the centre and anteriorly, but in the hinder part it is more decidedly rugose, the ridges being here higher and the enclosed areæ larger. Near the intercostal sutures, more particularly in the inner halves of the costal bones, the sculpture is partially effaced and consists of low, poorly defined parallel ridges at right angles to the sutures, forming a distinct border, with a maximum breadth of about 5 mm. A smooth border,

broadest at the sides of the carapace and narrowest in front, extends along the whole of the peripheral edge.

As regards a divided first neural in species of this genus, it is interesting to note that Lydekker, in describing *T. melitensis*, from the Miocene of Malta, in 1891 (Quarterly Journal of the Geological Society, vol. XLVII, p. 37, fig. 1), mentions the occurrence in the Miocene species of a divided first neural, and remarks (p. 37) that "all the fossil species hitherto described, of which the entire carapace is known, agree with the normal type in having but a single long neural between the first pair of costals."

Measurements.

	M.
Length of carapace along median line ($18\frac{1}{2}$ inches)	·470
Maximum breadth of carapace ($23\frac{2}{10}$ inches)	·590
Breadth of first costal at inner end	·075
Thickness of same near inner end	·009
Thickness of same at outer end	·012
Breadth of fifth costal at outer end	·119
Thickness of same at outer end	·013
Breadth at mid-length of seventh costal	·036
Thickness at centre of eighth costal	·010
Maximum breadth of neural 1	·056
Maximum breadth of neural 1a	·039
Length of same	·043
Thickness of nuchal plate at left end	·018
Length of vertebral centrum	·045

Belly River series, Red Deer River, 1897, 1898 and 1901; besides the carapace above described, separate costals and neurals, and parts of the endoskeleton.

Also in 1880, Professor John Macoun, neurals and fragments of costals, from Mackay creek, near Walsh, a station on the C. P. R., about twenty-eight miles east of Medicine Hat; and in 1881, Dr. G. M. Dawson, from Belly river, N.W.T. (No. 41), fragments of costal bones.

ADOCIDÆ.

ADOCUS, Cope.

ADOCUS (?) LINEOLATUS, Cope,

Adocus (?) lineolatus, Cope. 1875. Report U. S. Geol. Survey Terrs., vol. ii. Vertebrata of Cretaceous Formations of the West, p. 92, pl. vi, figs. 11 and 12.

This species, readily recognized by its neat and characteristic sculpture, is represented by two well preserved fragments, one, part of the right hyoplastral, the other, from the margin of the carapace in advance of the right axillary notch. The sculpture has the appearance of that of *Adocus variolosus*, in miniature, with the roughness worn down.

Belly River series, Red Deer river, 1901.

Adocus variolosus, Cope. (sp.)

Plate II, figs. 1, 2 and 3.

Compsemys ogmius, Cope. 1875. Report on the Geology and Resources of the forty-ninth parallel, appendix B.

Compsemys variolosus, Cope. 1876. Proc. Acad. Nat. Sci. Philadel,, vol. xxviii, p. 257.

Adocus variolosus, Lambe. 1901. Ottawa Naturalist, vol. xv, p. 63, pls. iii, iv, v, and vi.

The proportions of the component êlements of the plastron of this species can be seen by referring to figures 4 and 5, where restored outlines are given, based on two fragments of the same shell, which are represented in the figure by the shaded portions. The sutures between the bones are shown by the sinuous lines and the boundaries of the shields by the heavy ones. The dotted lines represent the supposed shape of the end of the posterior lobe, the direction of the sulcus defining the front limit of the femoral shields, and the position of the sulcus that probably crossed the xiphiplastrals, whilst the extent of the hypoplastrals is conjectural.

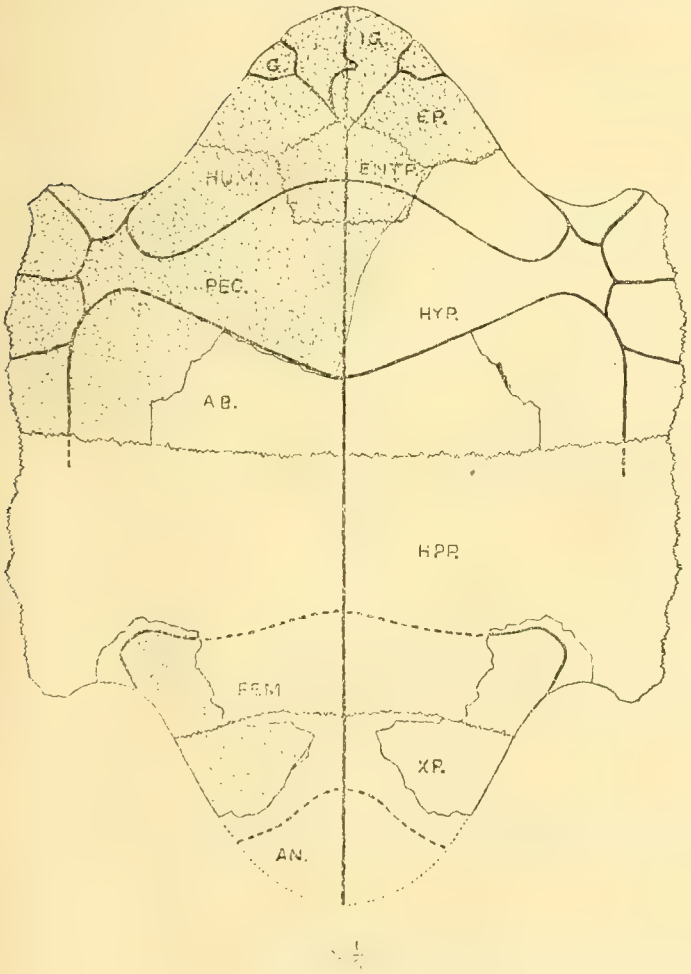


Fig. 4—Plastron of *Adocus variolosus*; one-sixth the natural size.

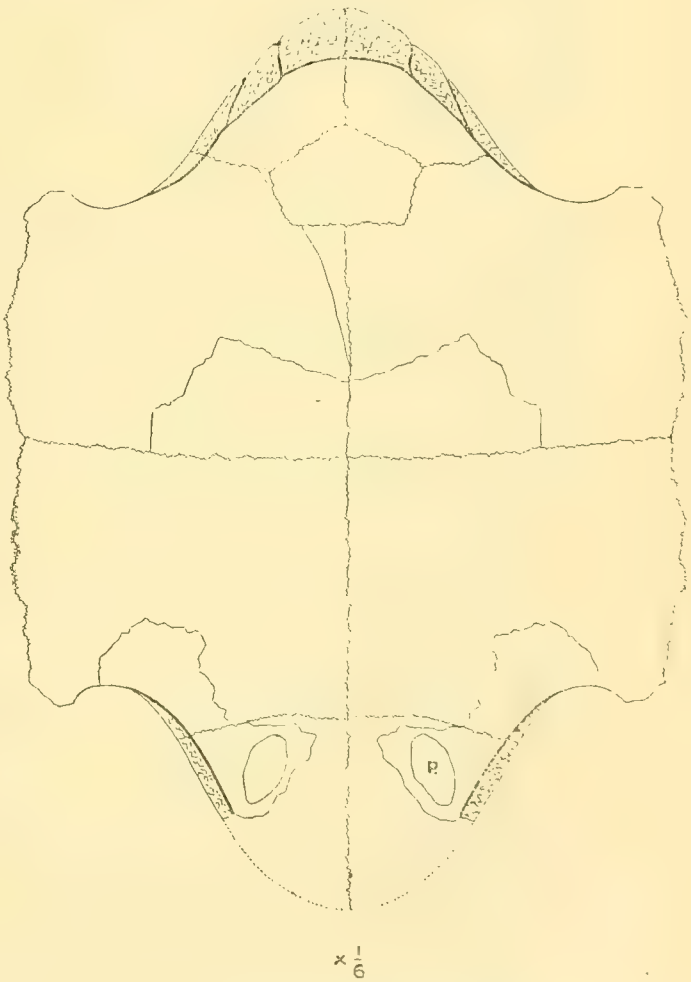


Fig. 5—Uppper or inner surface of the same plastron, from Red Deer river, Alberta.

IG, Intergular shield; *G*, Gular do.; *HUM*, Humeral do.; *PEC*, Pectoral do.; *AB*, Abdominal do.; *FEM*, Femoral do.; *AN*, Anal do.; *EP*, Epiplastral bone; *ENTP*, Entoplastral do.; *HYP*, Hyoplastral do.; *HPP*, Hypoplastral do.; *XP*, Xiphiplastral do.

The plastron is flat except at the sides where it bends evenly upward, the lobes are short and broad, and the sternal bridge long. The entoplastral is roughly pentagonal and rather broad. The epiplastrals are of not unusual size and shape, whilst the hyoplastrals are relatively large. A divided intergular shield separates two small gulars, behind which are well developed humeral shields. The pectorals narrow rapidly toward the sides where they and the abdominals meet a series of inframarginals that overlap the peripheral bones. All the sulci are deep and conspicuous except those marking the position of the inframarginals, the anterior boundaries of the gulars, and the division of the intergular. These latter, however, are sharply and clearly defined. The sutural line between the hypoplastrals and the xiphiplastrals is shown in the smaller of the two fragments.

The sculpture consists, when most rugose, of well excavated pits of a rounded hexagonal outline arranged quincuncially; the dividing ridges are angular and narrower than the pits are wide, their angularity and height being more pronounced at the junction of every three pits with each other. The formation thus, of three-surfaced, pyramidal projections between the excavations, gives to the shell of this turtle its very characteristic and rugose appearance. There are about seven pits in a space of 20 mm. In places a number of pits, as many as half a dozen or more, may coalesce so as to form a continuous groove. The sculpture is most rugose near the edges of both carapace and plastron, elsewhere its roughness is modified and generally toward the centre of the shell the surface is comparatively smooth.

On the inner or upper side of the plastron (fig. 5, page 39) the rugose sculpture extends inward for some distance from the free edges of the lobes, more particularly at the extreme anterior end, where also the bone is very much thickened. A decided thickening also occurs in the axillary region. The oval outlines on the xiphiplastrals (P, fig. 5) show the position of smooth, slightly raised, flat surfaces that are apparently facets for the articulation of the pubic bones.

Large fragments of the carapace show that the costals are thin and are united to the comparatively thick marginal bones by suture and that the sulci are deep and well defined. In some of the marginal bones the rib-prolongations from the adjacent costals are preserved. The rib-heads of the costals are apparently well developed.

In 1901, the anterior half of a plastron (fig. 6, page 41), with the front border of the carapace intact, was obtained below the mouth of Berry creek. This specimen, representing an individual, with a plastron about ·840 mm. in length, gives the relative position of the plastron to the carapace anteriorly and also shows an enlargement of the right pectoral shield to the left of the median line of the plastron resulting in a decided diminution in the size of the left pectoral shield.

Additional material includes two or three neural bones, some of the bones of the endoskeleton and a few small, thick, conical scutes from the tail. These latter have an upper surface whose sculpture is an exaggeration of that of the most rugose parts of the shell.

The types of *Compsemys ogmius*, Cope, from the "Fort Union group" of Milk river, consisting of two small, poorly preserved fragments of costal bones, show sculpture markings so similar to those characteristic of *A. variolosus*, that the writer is of the opinion

that the two species are identical. On account of the poorness of the type specimens of *C. ogmius* and to avoid confusion the specific name *variolosus* is retained.

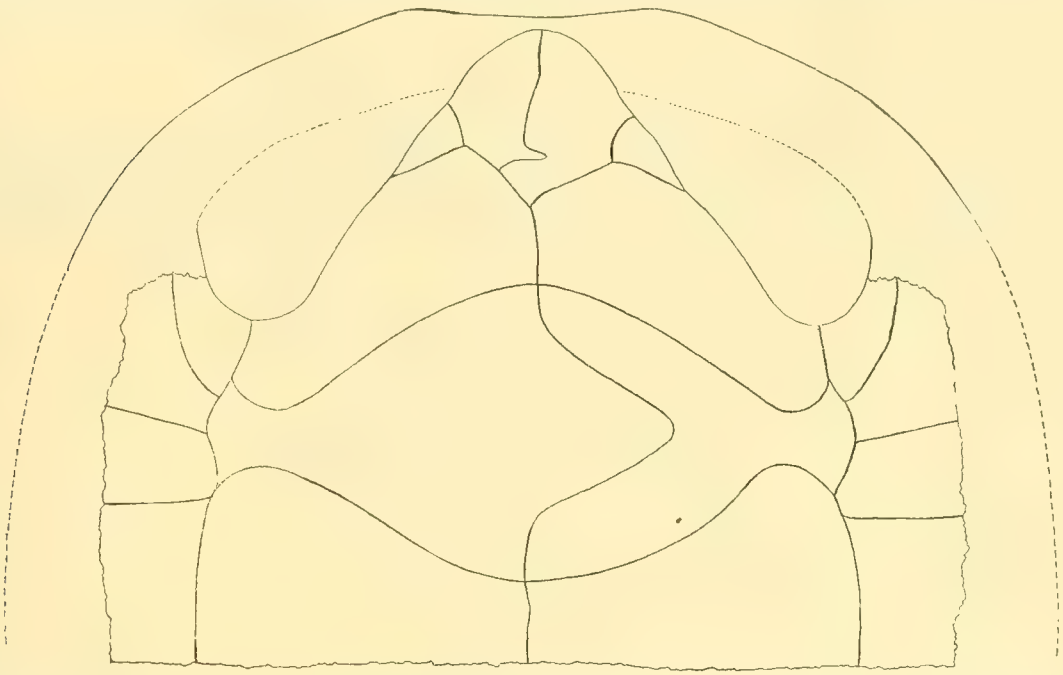


FIG. 6.—Anterior half of the shell of *Adocus variolosus*, from Red Deer river ; ventral aspect showing the front margin of the carapace, One-fifth natural size.

The foregoing characters indicate a Chelonian that cannot be retained in the genus *Compsemys*, which is closely allied to *Pleurosternon* and possesses a mesoplastral element. The presence of two small gular shields separated by a divided* or double intergular shield (in reality two intergulars), and of a series of inframarginals, the absence of a mesoplastral and of a sutural union of the pelvis with the plastron, together with an abbreviation of the lobes and a decided lengthening of the sternal bridge are characters that suggest such close affinities to the genus *Adocus* of Cope, that this species has been referred to that genus.

Measurements.

	M.
Estimated length of plastron ($28\frac{1}{2}$ inches)	·720
Length along median line from anterior end to posterior border of pectoral shield	·295
Breadth from median line to lateral suture (= half of breadth of plastron)	·280
Length of entoplastral	·085
Maximum breadth of entoplastral	·123
Thickness midway between gulars	·035
Thickness at centre of gular shields	·033
Thickness on median line at posterior border of pectoral shield	·013
Thickness at posterior edge of hyoplastral near left boundary of abdominal shield	·007
Thickness in axillary region near lateral suture	·032
Thickness midway between entoplastral and the axillary notch	·025

* G. Baur. Proc. Acad. Nat. Sci. Philadel, vol. xliii, 1891, p. 428. The genus *Adocus*.

Dr. O. P. Hay has informed the writer that in the type specimen there is little, if any, of the carapace represented, that the anterior lobe of the plastron is missing, and that the specimen shows the central portions of the plastron, and the posterior lobe, which latter is broadly rounded.

Belly River series, Red Deer river, 1897, 1898 and 1901.

Fragments of the shell had been collected as follows:—Professor John Macoun, Mackay creek, 1880 (Belly River series); Dr. G. M. Dawson, on Old Man river, below Fort McLeod, 1881 (Willow creek subdivision of the Laramie); Mr. R. G. McConnell, Red Deer river, 1882 (Belly River series).

CHELYDRIDÆ.

Neurankylus. Gen. nov.

Neurankylus eximius. Sp. nov.

The carapace of a turtle, represented by costal and other bones, shown in fig. 7, is remarkable for certain peculiarities of structure.

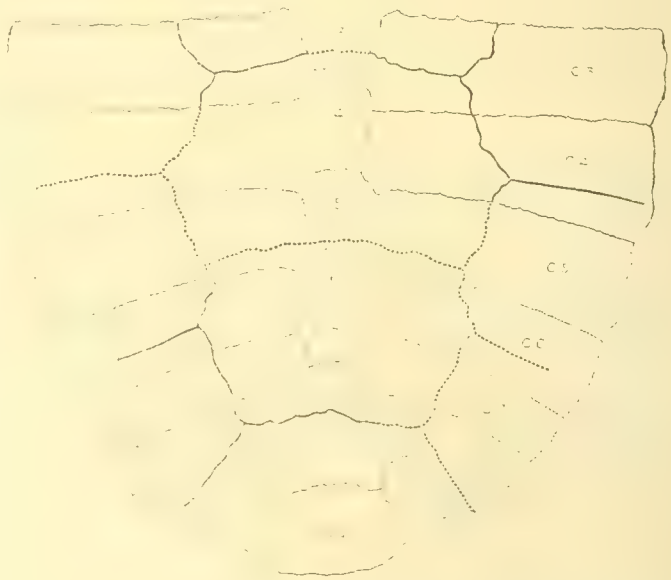


Fig. 7.—Part of the carapace of *Neurankylus eximius*, one-third the natural size. *N. 3, 4, &c.*, neural bones;, *C. 3, 4, &c.*, costal bones; *spy*, suprapygal bone; *r*, rib-end. The heavy lines indicate the boundaries of the epidermal shields, the sinuous ones the sutures between the bones, and the dotted ones the parts restored.

Of the seven costal bones obtained, from the middle and posterior parts of the carapace, four were found as shown, united to a large neural and a suprapygal bone. The other three costals, viz., the third pair and the right fourth were with the posterior costals but not in place. The fifth pair of costals was missing. The sulci indicating the junction of the costal shields seem to be normal in their position on the 4th, 6th and 8th costal bones. What is apparently a 9th costal succeeds the 8th costal bone. The 7th, 8th and 9th pairs of costals do not reach the median line of the carapace, but are separated by a large bone that is probably formed by a coalescence of the 8th neural with a suprapygal. This enlarged 8th neural is suturally united, for some distance with the vertebral ends of the 7th costal bones, for the whole of their breadth to the 8th costals and to a considerable portion of the supposed 9th costals. It increases in breadth posteriorly and effects a sutural union with a suprapygal whose breadth greatly exceeds its length. The rib-heads of the costals are well formed, those of the 9th costals being as fully developed as the others. No marginal bones were found with the remains of the carapace. Anterior to the point "a" on the outer edge of the 9th costal, vacuities seem to have occurred between the costals and the marginals, judging from the appearance of the outer margins of the 8th and 9th costals. From the point "a"

backward a suture extended for the union of the last marginal and the pygal bone. The surface of the neural and the suprapygal is raised medially into a low, rounded, longitudinal ridge.

No very decided sculpture is shown on the surface of the bones. Striations occur adjoining and at right angles to the sutures; elsewhere there is a slight roughness in places, more particularly toward the vertebral ends of the costals, which on close examination is seen to be produced by small, obscure and irregular depressions separated by very faint ridges. Comparatively large, concentrically curved groove-like markings also occur on two of the costals.

The great development of the last neural by apparent coalescence with a suprapygal, the resulting compression of the pygal region and the addition of a 9th pair of bones to the series of costals, form a combination of characters that is both interesting and unique.

A new genus is here proposed for this Mid-Cretaceous type that is thought to show greater affinity to the *Chelydridæ* than to any other group.

Belly River series, Red Deer river, 1901.

PLEUROSTERNIDÆ.

Baëna, Leidy.

Baëna hatcheri, Hay.

Baëna hatcheri, Hay. 1901. Annals of the Carnegie Museum, pp. 325-326, plate xv. "Description of a new species of Baëna (B. hatcheri) from the Laramie beds of Wyoming."

This species is represented from the Cretaceous of Red Deer river by a specimen, fig. 8, in which the whole of the plastron is preserved with the anterior half of the carapace. The sutures between the bones are well defined and the sulci are distinct. The carapace has suffered slightly from distortion, but the plastron is admirably preserved leaving little doubt as to the specific identity of the Red Deer river turtle with the Wyoming type.

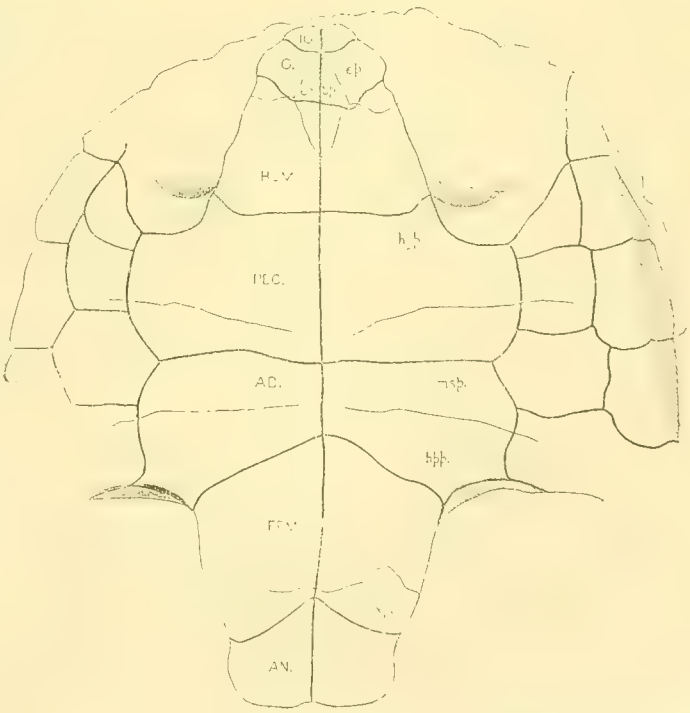


Fig. 8.—The plastron of *Baëna hatcheri*; from Red Deer river. One-half natural size. *IG*, Intergular shield; *G*, Gular do.; *HUM*, Humeral do.; *PEC*, Pectoral do.; *AB*, Abdominal do.; *FEM*, Femoral do.; *AN*, Anal do.; *ep*, Epiplastral bone; *entp*, Entoplastral do.; *hyp*, Hyoplastral do.; *msp*, Mesoplastral do.; *hpp*, Hypoplastral do.; *xp*, Xiphiplastral do.; * centre of front margin of carapace.

Fig. 9.—Front lobe of the plastron of another specimen; from Red Deer river. One-half the natural size.

Additional specimens consist of the anterior half of a plastron, parts of two other plastra, and a poorly preserved carapace of small size in which, however, the convexity of this half of the shell is well shown.

The variation in the direction of the gular and intergular sulci, in different individuals, to which Leidy drew attention in his description of *Baëna arenosa*,* from a higher horizon, is noticeable in the two Red Deer river specimens, neither of which agree exactly with the type.

Belly River series, Red Deer river, 1901.

Baëna antiqua. Sp. nov.

Part of the carapace of an apparently undescribed species of *Baëna* was obtained from Red Deer river, below Berry creek, in 1901. Near it was found the anterior end of a plastron that, judging from the surface markings, thickness of the shell, general appearance and size, evidently belongs to the same species and probably to the same individual.

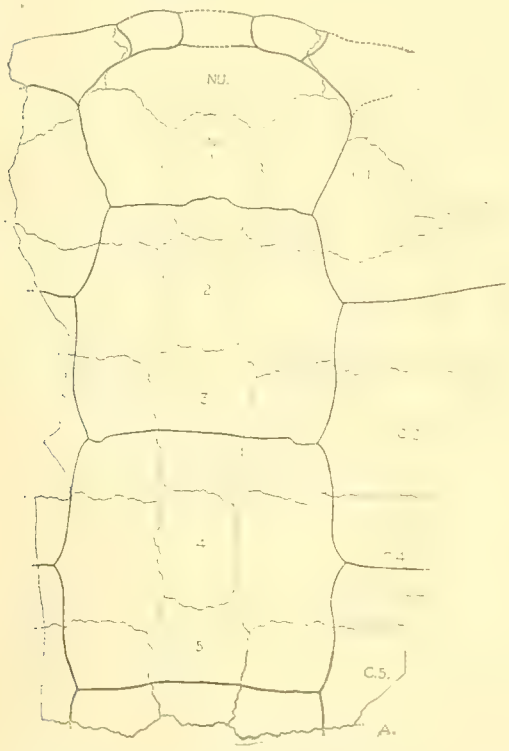


Fig. 10.—*Baëna antiqua*; A, part of the carapace; B, lower surface of anterior lobe of plastron; C, upper or inner surface of anterior lobe of plastron. One-half the natural size. The sinuous lines indicate the sutures between the bones, the heavy ones the boundaries of the epidermal shields. The letters are as in preceding figures.

What is preserved of the carapace (figure 10, A) is in an excellent state of preservation. Five neurals in all are represented with five pairs of costals. The sutures are sinuous and fine but can be traced with ease. The sulci are very distinct.

The neurals are rather irregular in shape and of nearly equal size. The costals partake of the same irregularity of outline. The outer surface is almost smooth, the only unevenness being due to a few striations and depressed, roughened markings erratically disposed. Striations also occur at right angles to the sutures, forming an obscure border sculpture. The vertebral shields are broader than long, more especially the first one. The rib-heads are well developed. There is a strong and abrupt thickening

* Report U. S. Geol. Surv. Terrs., 1873. vol. i. Fossil Vertebrates, pl xv, figs. 1-5.

in the axillary region but elsewhere the shell is thin. The anterior border is evenly rounded.

The front end of the plastron (figs. 10, B and C) is rather broad in proportion to the length of its component parts of which the epiplastrals, the entoplastral and small portions of the hyoplastrals are preserved. The entoplastral, seen from below is diamond shaped, a little broader than long, and placed far forward on account of the shortness of the suture between the epiplastrals in front. Seen from above, or within, the entoplastral is much longer than broad, its breadth being reduced and its posterior half prolonged backward. Similar extensions of the posterior border also occur in the upper surface of the epiplastrals. Sulci, as indicated in the figure, define the boundaries of the gular and intergular shields.

Other fragments, in the collection, may help to further elucidate the structure of the shell of this species.

Belly River series; below the mouth of Berry creek, Red Deer river, 1901.

Measurements.

	M.
Extreme length of specimen, on median line	·186
Estimated length of carapace	·290
Length of 1st neural	·033
Breadth of same	·027
Length of 2nd neural	·030
" 3rd "	·037
" 4th "	·032
" 5th "	·031
Length of 3rd vertebral shield	·065
Extreme breadth of same	·075
Breadth of entoplastral, lower surface	·027
Length of same	·022
Thickness near front margin of carapace	·007
" " plastron	·0065
Thickness of 2nd costal at proximal end	·005
" " distal end	·004
Maximum thickness in axillary region	·026

Belly River series, Red Deer river, 1901.

RHYNCHOCEPHALIA.

CHAMPSOSAURIDÆ.

CHAMPSOSAURUS, Cope.

CHAMPSOSAURUS ANNECTENS, Cope.

Vertebræ, Leidy. 1860. Trans. Amer. Philos. Soc. Extinct Vertebrata from the Judith river and Great Lignite formations of Nebraska, p. 147, pl. 9, figs. 56–61.

Champsosaurus annectens, Cope. 1876. Proc. Acad. Nat. Sci. Philadel., p. 351.

This species, the type of the genus, is represented by a large number of vertebræ, none of which were found together in their proper relative positions, but in a few instances, a number, collected within limited areas, may represent incomplete series.

The vertebræ consist of cervicals, dorsals, caudals and some from the sacral region. The anterior dorsals are keeled below, in the dorsal series the angularity gives way to a rounded lower surface, the sacrals are depressed and the caudals, early in their series, become laterally compressed. The posterior, inferior ends of the caudal centra present facets for chevron bones; in one anterior caudal, in particular, they are conspicuous with a pronounced enlargement of the centrum in their vicinity. In most of the dorsal vertebræ the neural arches have become detached, in the caudals the base at least is generally intact. The zygapophyses are well developed. The articular faces of the centra in the caudals are slightly concave, those of the dorsals are plane. There is a considerable variation in the size of the vertebræ.

It is altogether probable that more than one species is represented.

The following measurements in mm. are taken from a number of centra found with others within a limited area :—

—	Cervical.	Dorsal.	Sacral.	Anterior caudal.	Median caudal.	Late caudal.	Later caudal.
Length of centrum.....	13·5	17·0	17·0	18·5	15·5	13·0	13·0
Height of articular face.....	13·5	15·0	13·0	12·5	11·0	7·0	5·3
Breadth " "	13·5	17·0	15·0	14·5	10·0	6·0	4·5

A large dorsal from Mackay creek has the following dimensions :—length of centrum, 27·0 mm., height of articular face, 22·0 mm., breadth of articular face, 23·0 mm.

Champsosaurus is known, also, by comparatively complete skeletons from the Lower Eocene of Rheims, France, and Erquelinnes, Belgium.

Belly River series, Red Deer river, 1897, 1898 and 1901.

Vertebræ were collected at Mackay creek, near Walsh station on the line of the C. P. R., in 1880, by Professor John Macoun; on Belly river, N. W. T. (Nos. 40 and 41), in 1881, by Dr. G. M. Dawson; and at Ross coulée, near Irvine station, by Mr. T. C. Weston, in 1884.

SQUAMATA.

Troödon, Leidy.

Troödon formosus, Leidy.

Troödon formosus, Leidy. 1857. Proc. Acad. Nat. Sci. Philadel., vol. VIII, p. 72, and 1860, Trans. Amer. Philos. Soc. Extinct Vertebrata from the Judith river and Great Lignite formations of Nebraska, p. 147, pl. 9, figs. 53, 54 and 55.

Two teeth from Red Deer river, below the mouth of Berry creek, agree with Leidy's type in every essential particular and are evidently referable to his species.

One of the specimens has eleven denticles on either side of its cutting edge and is slightly worn, near the apex, on its less convex side. The other has eleven denticles on one edge and is similarly worn near the top, but one or two serrations are broken off near the base of the opposite edge so that nine only can be counted. The hollow bases of both teeth are imperfect below.

Belly River series, Red Deer river, 1901.

This species is placed provisionally with the *Lacertilia*.

CROCODILIA.

Crocodilus humilis, Leidy.

Crocodilus humilis, Leidy. 1860. Trans. Amer. Philos. Soc. Extinct Vertebrata from the Judith river and Great Lignite formations of Nebraska, p. 146, pl. 11, figs. 9–19.

Teeth of this species are found abundantly in the rocks of the Belly River series. They are in the form of elongate cones, slightly curved inward, with two angular longitudinal ridges defining the slightly flattened inner side. They are generally quite smooth, but in some specimens, a distinct folding or corrugation of the surface is observed, more particularly in the upper half of small and medium sized specimens. Their bases are slightly excavated. The apices generally show signs of wear.

Numerous examples also occur of the low, rounded germ-teeth, figured by Leidy, that have a silky lustre, caused by the presence of minute, close-set, discontinuous ridges in the enamel, converging toward the apex. They are, however, sometimes elongated so as to be moderately pointed above.

Belly River series, Red Deer river, 1897, 1898 and 1901.

Teeth of *C. humilis* had previously been collected, but not determined, from the same series of rocks, as follows:—Professor John Macoun, Mackay creek, near Walsh, a station on the line of the Canadian Pacific Railway, east of Irvine, 1880; Dr, G. M. Dawson, Belly river, N.W.T. (Nos. 40 and 41), 1881; Mr. T. C. Weston, Ross coulée, near Irvine, 1884, and Irvine coulée, also near Irvine, 1888.

Bottosaurus perrugosus, Cope.

Bottosaurus perrugosus, Cope. 1875. Report U.S. Geol. Survey Terrs., vol. II. Vertebrata of Cretaceous Formations of the West, p. 68, pl. VI, figs. 5–8.

A left mandibular ramus, from which the posterior ends of the dentary and splenial bones and the articular and coronoid elements are missing.

The supra-angular shows, on its inner posterior surface, the facet for the articular bone, and also in its lower border the posterior end of the external mandibular foramen. The lower margin of the internal mandibular foramen is seen in the anterior half of the angular. The external surface of the dentary shows small, deep pits directed forward and inward, from each of which a shallow groove passes backward for a short distance; the pits are arranged in somewhat obscure longitudinal rows. The lower outer surface of the angular is rugose, from the presence of deep grooves running in a longitudinal direction. This outer sculpture changes, in the supra-angular, into an irregular and bold network of ridges enclosing deep, sunken areæ. Altogether the surface markings are as shown by Cope in his figures.

There are sixteen sockets for teeth, the second, third and fourth of which, counting from the front, still retain a hollow root. The symphysis is well shown. The front end of the splenial enters into the formation of nearly one-fourth of the symphysis. A foramen passes through the splenial immediately behind the symphyseal surface.

The species is still further represented, in the collections, by the occiput of another individual, obtained in 1901, and requiring further study. Numerous vertebræ and bony scutes of Crocodilia have also been obtained, some of which will probably be found to belong to this species

Measurements.

	M.
Estimated length of ramus	·355
Width in front	·031
Height in line with posterior margin of external mandibular foramen	·053
Width of lower border where the last measurement was taken	·016
Height of symphysis	·018
Length of same.... approx	·047
Width of first two sockets	·011
Length of next three	·0055
Length of tenth and eleventh sockets	·008
Length of fifteenth socket	·006
Distance between outer edges of quadrates, posteriorly	·201
Height of foramen magnum	·014

Belly River series, Red Deer river, 1897, 1898 and 1901.

DINOSAURIA.

DRYPTOSAURIDÆ.

Deinodon, Leidy.

Deinodon horridus, Leidy

Deinodon horridus, Leidy. 1856. Proc. Acad. Nat. Sci. Philadel, vol. viii, p. 72.
" " Leidy. 1860. Trans. Amer. Philos. Soc. Extinct Vertebrata from the Judith River and Great Lignite formations of Nebraska, p. 143, pl. 9.

A number of megalosauroid teeth, the largest of which measures 90 mm. on its convex curve, are referred to this species. The general shape of the teeth and the serrations agree closely with some of Leidy's figured types, viz., those shown in figures 21 to 32 of plate 9 of the above quoted work.

A few phalanges (including terminal ones) and a metatarsal with fragments of others, are probably also referable to this species.

Belly River series, Red Deer river, 1897, 1898, 1901.

That Leidy was correct, in supposing that the teeth to which he gave the name *Deinodon*, belonged to a single animal, is most probable, in view of our present knowledge of the teeth of carnivorous dinosaurs. The teeth of *Deinodon* were evidently slightly heterodont, those used, at a later date, for the foundation of the genus *Aublysodon* being probably the anterior teeth of *Deinodon*.

Dr. O. P. Hay has recently pointed out (American Geologist, 1899, vol. xxiv, p. 346) that the name *Deinodon*, as originally spelt, is not preoccupied. This name, as a generic term is here retained and the name *Aublysodon* is regarded as a nomen nudum.

Deinodon explanatus, Cope. (sp.)

Plate XV, figs. 11 and 12.

Lælaps explanatus, Cope. 1876. Proc. Acad. Nat. Sci. Philadel., vol. xxviii, p. 249.

A small tooth agreeing with Cope's description. The posterior concave edge is minutely denticulated throughout its length. The convex edge, in its apical half, is still more minutely serrate. One side is almost flat, the other gently convex.

Measurements.

		M.
Length from centre of base to apex		·012
Diameter at base	antero-posterior	·006
	transverse	·003

Belly River series, Red Deer river, 1901.

Many small teeth of the *Megalosauroid* type have been collected from these beds. Probably some of them will be found to belong to other species of this genus described by Cope.

ORNITHOMIMIDÆ.

Ornithomimus, Marsh.

Ornithomimus altus. Sp. nov.

Plates XIII and XIV, and plate XV, figs. 1–8.

A hitherto undescribed species of dinosaur, belonging to the *Ornithomimidæ* and referable to the genus *Ornithomimus* of Marsh, is represented by a complete right hind limb (including the foot), the phalanges of the left foot in place, a pubic bone, and an ischium, of one individual.

With these, as probably belonging to the same species, are included a posterior dorsal vertebra, caudal vertebræ of remarkable form, phalanges of the manus and a number of teeth of peculiar shape.

The femur, tibia, metatarsals and phalanges of the pes, except the terminal ones, are hollow.

The femur is shorter than the tibia. The astragalus is closely applied to but does not coalesce with the distal end of the tibia; it has a well developed ascending process apposed to the front face of the tibia. The fibula is slender and the tibia has a prominent cnemial crest. The calcaneum and the tarsal bones were found in place. Metatarsal III, as in *Ornithomimus velox*,* Marsh, fits closely against metatarsals II and IV, and is, a short distance above its distal end, triangular in section with its flat face foremost. It becomes attenuated above and passes behind the other two metatarsals. Metatarsal V, represented by a short, laterally compressed, slightly curved bone, lies close to the proximal end of metatarsal IV.

The phalangeal formula is 3, 4, 5; digit III is the longest and digits II and IV are of about equal length. The terminal phalanges are sharply pointed in front, rather straight, flattened below and deeply grooved on the sides. The grooves are carried forward to the extreme point and indicate the presence, during life, of a long but not sharply curved or pointed claw. The other phalanges have deep pits, one on each side of their distal extremities. The shape of the terminal phalanges suggests a foot, not suitable for grasping but adapted rather for speed in running, an idea carried out by the slenderness and lightness of all the bones of the leg.

The posterior dorsal vertebra, plate XIV, fig. 1, is decidedly amphicœlous, the concavity in the anterior face of the centrum being more marked than in the posterior one. The

*Sixteenth Annual Report, U. S. Geol. Survey, 1896, plate lviii., fig. 2.

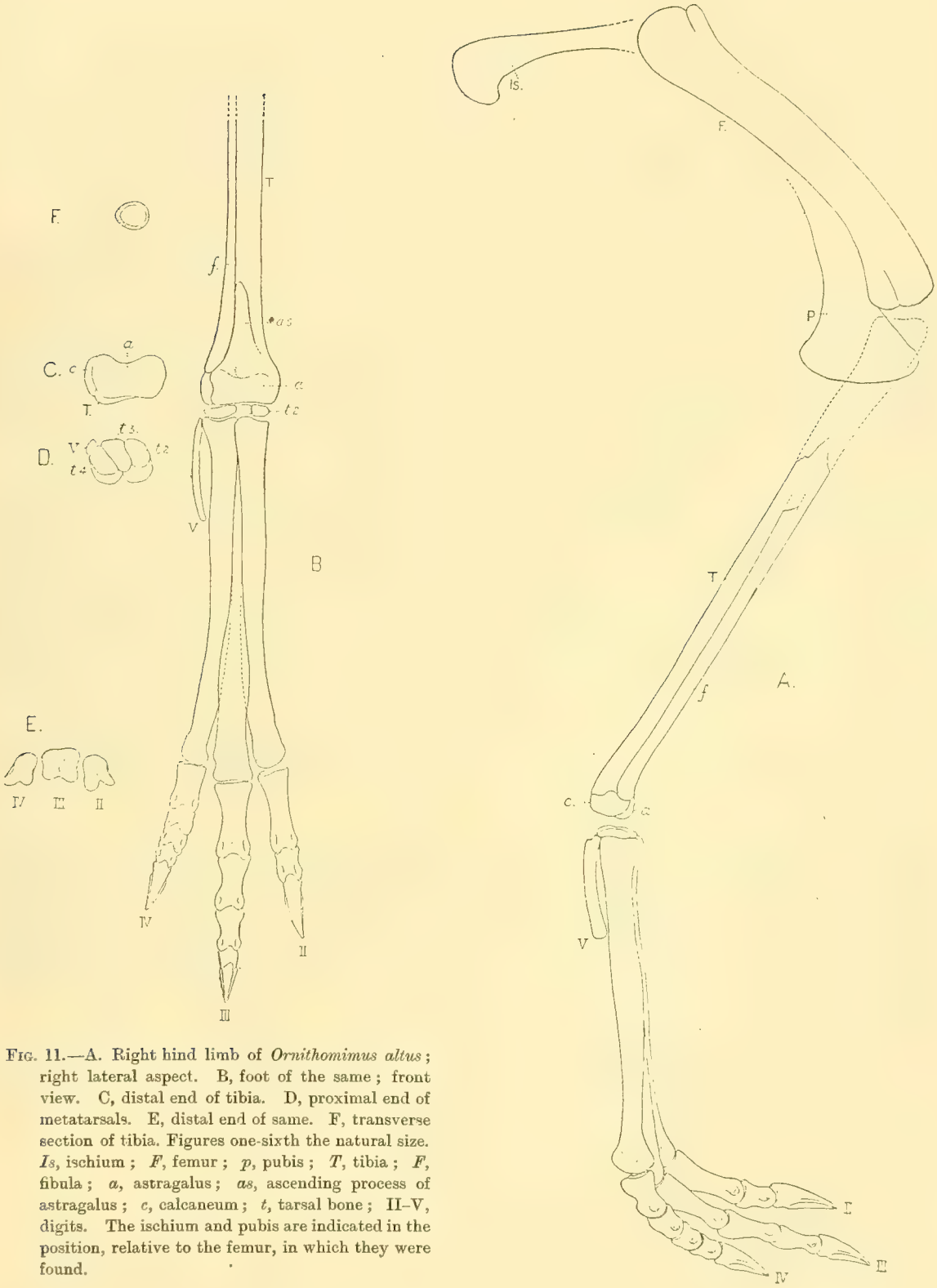


FIG. 11.—A. Right hind limb of *Ornithomimus altus*; right lateral aspect. B, foot of the same; front view. C, distal end of tibia. D, proximal end of metatarsals. E, distal end of same. F, transverse section of tibia. Figures one-sixth the natural size. *Is*, ischium; *F*, femur; *p*, pubis; *T*, tibia; *F*, fibula; *a*, astragalus; *as*, ascending process of astragalus; *c*, calcaneum; *t*, tarsal bone; II–V, digits. The ischium and pubis are indicated in the position, relative to the femur, in which they were found.

centrum is constricted at mid-length so as to have concave sides and lower surface, there being at either end of the latter a broad median groove. The neural arch does not reach far below the top of the centrum. The diapophyses (imperfect in the specimen) have stout bases, relatively broad in their antero-posterior diameters. The faces of the prezygapophyses are directed obliquely inward. The neural spine is well developed, short, deep from back to front, shallowly concave on its sides, with rugose, slightly excavated, anterior and posterior surfaces. The centrum is hollow, its walls dense and about 2·5 mm. thick at mid-length, the inner space extending to within about 6 mm. of either end.

The caudal vertebræ, plate XIV., figs. 2—5, and plate XV., figs. 1—5, supposed to belong to this species, are remarkable for the suppression of the neural spine and the forward horizontal extension of the prezygapophyses to a distance in advance of the anterior end of the centrum nearly equal to the length of the centrum itself. The postzygapophyses are represented by a backwardly directed, laterally compressed, nearly horizontal process that fitted between the prolonged prezygapophysial processes of the succeeding vertebra. The centrum is long compared with its height, slightly concave on its sides and lower surface, with a strong median groove below. In different specimens its interior may be moderately hollow or instead a number of vacuities of variable size may be present. Small facets, for the attachment of the chevron bones, are present at the lower, posterior ends of the centra; these are not recognized at the anterior ends. The neural spine is sometimes represented by a narrow, rounded ridge (shown at "w" in the specimen figured on plate XV., fig. 2). The prezygapophysial processes are broadly expanded laterally, contracting and thinning gradually anteriorly, their outer edges overhanging the sides of the anterior end of the centrum and extending lower than the median upper surface of the same; their lower surfaces are slightly striated longitudinally. The neural canal is small, its outlet, anteriorly, is wider than high and is roofed over to a point above the anterior end of the centrum. These caudal vertebræ indicate a tail of considerable length but their manner of articulation would scarcely admit of much lateral motion.

A number of phalanges of the supposed manus of this species are also hollow but present a difference in the shape of the terminal phalanges which are curved and laterally compressed with a groove on each side extending from the apex backward and dividing into two branches toward the proximal end. Judging from the size of these phalanges the manus was smaller than the pes, and their shape suggests a grasping capacity; the terminal phalanges were probably encased in sharp, hooked claws giving their possessor the power of tearing its prey.

Two bones, probably the distal ends of the first metatarsal* and the first metacarpal, were found with, the phalanges of the manus above referred to, phalanges of the pes, a separate astragalus and a calcaneum.

* "Fore and Hind Limbs of Carnivorous and Herbivorous Dinosaurs from the Jurassic of Wyoming," Bulletin Am. Mus. Nat. Hist., vol. xii., 1899, by Henry Fairfield Osborn, figs. 3, 4 and 4a.

Measurements.

	M.
Length of femur	·430
Estimated length of tibia (from two specimens)	·560
Antero-posterior diameter of shaft of femur at mid-length	·045
Circumference of shaft of tibia at mid-length (of another individual)	·112
Transverse diameter of same tibia above distal end	·041
Width of cavity, in same direction, where preceding measurement was taken	·030
Length of metatarsal IV	·335
Length of metatarsal V (nonfunctional, imperfect at proximal end)	·100
Length of digit II	·164
Length of digit III	·213
Length of digit IV	·143

The tooth represented in figs. 12 and 13 of plate XIV is provisionally associated with this species and is regarded as being from the anterior portion of the jaw. A similar tooth, figured by Leidy, in his memoir on the Judith river vertebrata (Trans. Amer. Philos. Soc. 1859) is referred to in his description of the teeth of *Deinodon horridus* as an aberrantly formed specimen. Leidy suspected the tooth to be an incisor.

In the tooth figured on plate XIV, one only of the posterior keels is denticulated and that only for a short distance at the centre of its length; the other is smooth. Another specimen is apparently without denticulations.

A number of teeth of this shape, with others intermediate in form between them and the orthodox *Megalosauroid* tooth, were collected in the Red Deer river district. They are referred to the present species on account of their frequent occurrence with and near the remains of *O. altus*.

The estimated length of *Ornithomimus altus* is 22 feet.

Belly River series, Red Deer river, 1897, 1898 and 1901. The right hind limb with the phalanges of the left foot, were found in 1901, below Berry creek.

The following remains of this species besides those already mentioned have been collected; by Professor John Macoun, in 1880, on Mackay creek, near Walsh on the line of the C.P.R., phalanx of pes (Belly River series); by Mr. T. C. Weston, in 1884, at Ross coulée, near Irvine, about eighteen miles east of Medicine Hat, part of a caudal vertebra, phalanges of the pes and a phalanx of the manus (Belly River series); by Mr. Weston, in 1889, part of a caudal vertebra and phalanges of pes, labelled, Red Deer river, range xxi, tp. 32 west of 4th P.M. (Edmonton series).

STEGOSAURIDÆ.

Palæoscincus, Leidy.

Palæoscincus costatus, Leidy.

Palæoscincus costatus, Leidy. 1857. Proc. Acad. Nat. Sci. Philadel., vol. viii, p. 72, and 1860, Trans. Amer. Philos. Soc. Extinct Vertebrata from the Judith river and Great Lignite formations of Nebraska, p. 146, pl. 9, figs. 49–52.

In the collections are a few teeth that cannot be distinguished from the one figured by Leidy in the latter of the above two publications. Of these, an average specimen is of the same size as the type and has the same number of serrations. As the crowns of some are worn the exact number of serrations that the tooth had originally cannot always be ascertained. Their sides are smooth. They seem to vary little in form but are proportionately thicker, near the base of the crown, than the type.

Belly River series, Red Deer river below Berry creek, 1901.

Palæoscincus asper. Sp. nov.

Plate XVII, fig. 5.

The tooth for which the above name is proposed is in the form of a laterally compressed cone, with a serrate edge and rugose sides. The root was evidently cylindrical but has been broken off close to the base of the crown.

One side of the crown is more rugosely striated and flatter than the other which is decidedly convex. The trenchant edge has eighteen serrations, fifteen only of which are seen in a side view, as the last three on the right (as figured) are paired with three others of equally small size. The groove separating these three pairs is deep and decided. The other end of the tooth is flattened in an almost vertical direction; here the serrations curve toward the side of the greater rugosity. The broad apical denticle is the one that shows the most wear. The base of the crown is evenly rounded below to meet the fang.

This tooth differs materially from others of the genus described by Leidy and Marsh. The serrations are more numerous, the sides more conspicuously ridged, whilst the double row of denticles at one end of the cutting edge, besides being novel, is most interesting and instructive, in that it is suggestive of a progressive step toward the development of a double row of tubercles such as is found in the molars of the Multituberculates.

The specific name here suggested has reference to the rough sides of the crown of the tooth.

Measurements.

	M
Height of crown	·0055
Length of same	·006
Maximum breadth near base	·003

Belly River series, below Berry creek, 1901.

Stereocephalus. Gen. nov.

Stereocephalus tutus. Sp. nov.

Plate XI, plate XII, figs. 1, 2, 3, 4 and 5, and plate XXI, figs. 6, 7 and 8.

The specimen of which views from above, from the side and from below are given on plates XI and XII, represents part of the plate-protected cranium of a herbivorous dinosaur, that is, apparently, quite distinct from any hitherto described.

With the head was found a transverse series of coössified sharply keeled scutes which will be described farther on.

The part of the head preserved is strongly convex transversely, but only moderately so from front to back. Coössified plates cover the whole of the upper surface and are continued down on the vertical sides. They are arranged with a certain amount of bilateral symmetry, are quite small at the centre and toward the back, but are larger in front and very much more so on the sides. They are for the most part irregularly five or six sided, with rather undulatory surfaces that are marked by an irregular, raised, structural cross-hatching, feebly suggestive of the surface markings of the plates of *Nodosaurus textilis*, Marsh. Small vascular openings and grooves are also numerous on the surface. The edges of the plates are as a rule angular and sometimes raised. Each plate has its limit defined by a deep circumscribing furrow, so that although they are coössified and form a continuous surface covering to the head, they do not lose their individuality. A rounded node, or an incipient keel is noticed on some of the plates.

The removal of sandstone from the lower surface of the specimen revealed the bones of the palatal region (plate XII, fig. 2). The interpretation of these elements are as indicated by the letters. The back ends, only, of the palatines (p.) are seen, meeting the pterygoids in a suture indicated at "s." From here the latter bones (pt.) extend backward on either side of interpterygoid vacuities (v.). The ridge (pb.) represents the presphenoid and basisphenoid elements; it is bent posteriorly to one side in the specimen, which has been subjected to considerable pressure from above and is somewhat crushed behind.

From this interpretation of the bones of the palate it would appear that the part of the armature preserved covers the upper part of the head near the union of the nasals with the frontals. No indication of the orbits can be detected and it is probable that they were placed far forward in the head.

Part of a rib, having a T-shaped transverse section (Plate XII, fig. 5), such as is characteristic of the heavily armoured *Stegosauria*, was found separately but in the same locality, and is provisionally associated with *S. tutus*. The finding of such a rib is sufficient evidence of itself to prove the existence, during the time of the deposition of the Belly River series, of a large dinosaur having a heavy protective covering of bony plates

Measurements.

	M.
Antero-posterior diameter of specimen	·250
Greatest transverse diameter	·210
Height of centre of upper surface above the level	·125
Width of interpterygoid vacuities ..... about	·040
Maximum thickness of cranial armature ..... about	·016

With the head, just described, were five keeled, bony scutes or plates that have since been found to fit together in the form of an arch (plate XII, figs. 3 and 4), whose sides curve forward as well as downward. This oblique curve places the lower, paired scutes, as seen when the arch is viewed from above, a little in advance of the upper pair which is again slightly in advance of the median plate

The scutes rest on and are ossified to a thickness of bone that constitutes the inner, continuous surface of the arch. This band of bone, ornamented above by paired ossicles, suggests the possibility of its being the back border of the posterior crest of the species to which the head armature, above mentioned, belonged.

This suggestion is given credence from the fact that the concave edge of the band of bone on which the scutes rest is fractured, whilst the convex edge appears to be intact.

Numbering the ossicles from the right, the junction between Nos. 1 and 2 was perfect, as were also those between Nos. 3, 4 and 5, but in the case of Nos. 2 and 3 the fractured edges did not fit with sufficient exactness to remove all doubt as to their being placed side by side, although the continuity and symmetry of the curve of the under surface seemed complete. It is possible that one or two scutes are missing from between Nos. 2 and 3, especially as fragments of similarly shaped scutes were found at the same spot. If an additional scute completed the series it probably would have been the mate of the present median one, or if two were required to fill the gap (if such a gap exists) one would be on the median line, the other would correspond with No. 3 to form another pair. The addition of one or two scutes to the series would result only in extending and possibly flattening the curve.

The median scute is apparently symmetrical, the others are asymmetrical, forming pairs with reversed lateral proportions.

The scutes have an irregularly oval basal outline, are sharply keeled, with sloping sides shallowly excavated from the keel downward but convexly curved from front to back, their basal edges are defined by an engirdling furrow below which, at a lower level, they are laterally expanded to meet each other in a plane surface. A very small ossicle rises above this intermediate basal surface between Nos. 3 and 4. Vascular markings are conspicuous on the sides of the scutes.

From the appearance of the outer, basal edges of scutes Nos. 1 and 5, it seems probable that these scutes constituted the lateral terminations of the series.

Measurements of transverse series of scutes.

	M.
Height of apex of median keel above the level	·190
Height of centre of inner surface of arch above the level	·125
Width of inner spread of arch below	·236
Average height of apices of keels above inner surface of arch	·072
Basal breadth of the scutes (Nos. 2 and 4) on either side of the median one	·075
Basal length of same	·143
Thickness of bone on which the scutes rest, about	·010

Belly River series, Red Deer river, 1897.

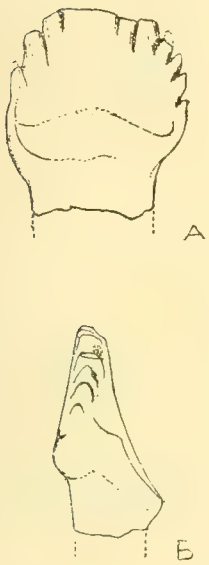


Fig. 12.—*Stereocephalus tutus.* Tooth, from Red Deer river, *A*, side view; *B*, end view. Twice the natural size. (*Provisionally associated with S. tutus.*)

The tooth shown in fig. 12, is of the *Stegosaurian* type. It differs from those, of the Red Deer river district, referred to the two species of *Palæoscincus*, and is about twice as large as those of *P. costatus.* It is figured here with the idea that it may eventually prove to belong to *S. tutus.* It was collected below Berry creek, on Red Deer river, in 1901.

A spinous dermal plate of massive proportions, fig. 13, A and B, is referred to this species on account of its similarity, in structure and surface markings, to the postcranial keeled scutes described above. This specimen was collected in 1897. Another large plate similar in general proportions to the above and nearly as large, as well as numerous others of different sizes and of a variety of shapes, were collected in 1901.

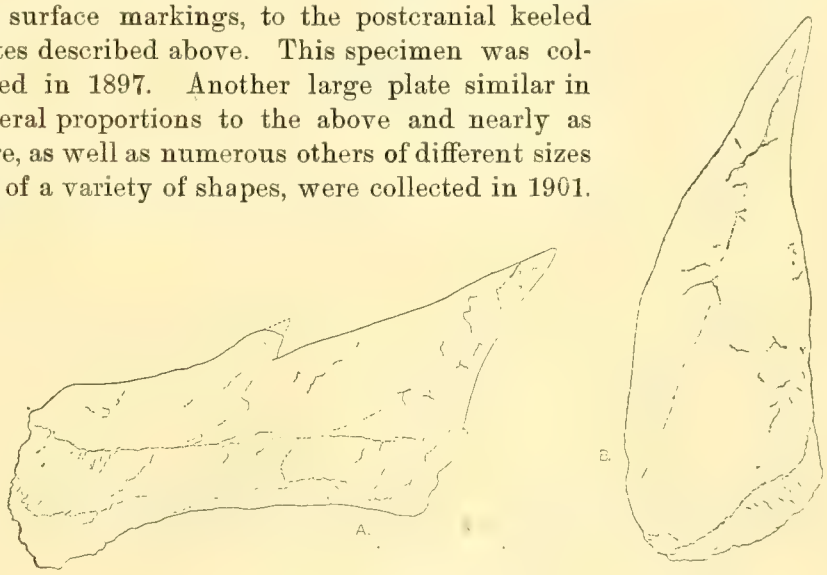


Fig. 13.—*Stereocephalus tutus.* Dermal plate from Red Deer river; one-sixth the natural size. *A*, side view; *B*, view from above. (*Provisionally associated with S. tutus.*)

CERATOPSIDÆ.

Monoclonius, Cope.

Monoclonius dawsoni. Sp. nov.

Plate XVI, plate XIX, figs. 4-6, and plate XX, figs. 3 and 4.

The remains of an apparently undescribed species of this genus, consisting of the skull of one individual and the posterior crest of another, are of especial interest. The

skull when found lay on its right side and although very much crushed, certain parts of it supply definite information as to its structure and size. The two orbits, the right maxilla, a quadrate and the occipital condyle were conspicuous and apparently in place, with a large posterior crest extending to the rear. Somewhat in advance of the orbits a horn core, of large size and apparently symmetrical form, occupied a position suggestive of a nasal origin, the nasal bones and the frontals being probably represented by the r agments filling the space between the orbit and the horn core (see fig. 14, from a measured drawing made before the parts of the skull were removed).

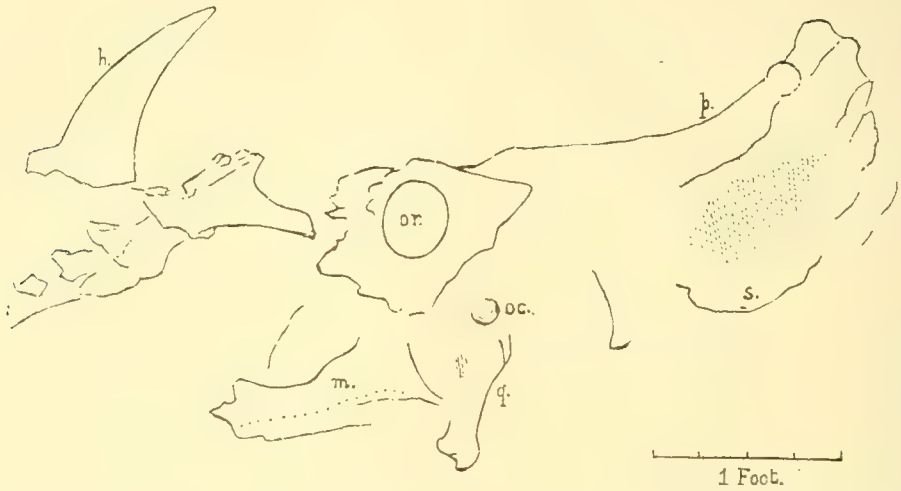


Fig. 14.—Head of *Monoclonius dawsoni*, from a sketch in the field; one-twelfth the natural size. *p*, parietal; *or*, orbit; *oc*, occipital condyle; *q*, quadrate; m, maxilla (inner side, showing a row of foramina); h, horn core; *s*, squamosal.

The large posterior crest forms the back part of the skull above; its exact shape is fortunately supplied by the admirably preserved specimen shown in outline. from beneath, in fig. 15. The surface of the bone, above the orbit and from there inward for a short distance toward the median line of the skull, is moderately smooth and shows no trace of a horn core.

With the separate posterior crest was found a horn core, similar in shape to, although not as well preserved as, the one belonging to the skull.

The posterior crest is composed of the parietals and squamosals coalesced. The former are represented by a flat, thin, smooth median portion that expands laterally both in front and behind; anteriorly it is deeply concave below and broadly convex above but posteriorly it thickens gradually and dividing to either side is continued forward as the squamosals in a broad curve to meet the anterior expansion. On either side of the median element is included a large supratemporal vacuity or fontanelle.

The posterior crest is somewhat saddle-shaped. Its sides are wavy, with a slight thickening of the bone in the posterior five of the seven corresponding convexities of the periphery, whilst a pair of inwardly directed spurs of bone, with their points turned slightly downward, are developed on its posterior border, one on each side of the median line. The intervacuital element is thickened along its median length and a more decided strengthening of the bone occurs along the posterior border, resembling in this respect

the corresponding part of *Monoclonius belli*, described further on. In all other parts of the crest the bone is thin, more particularly near and at the margin of the fontanelles

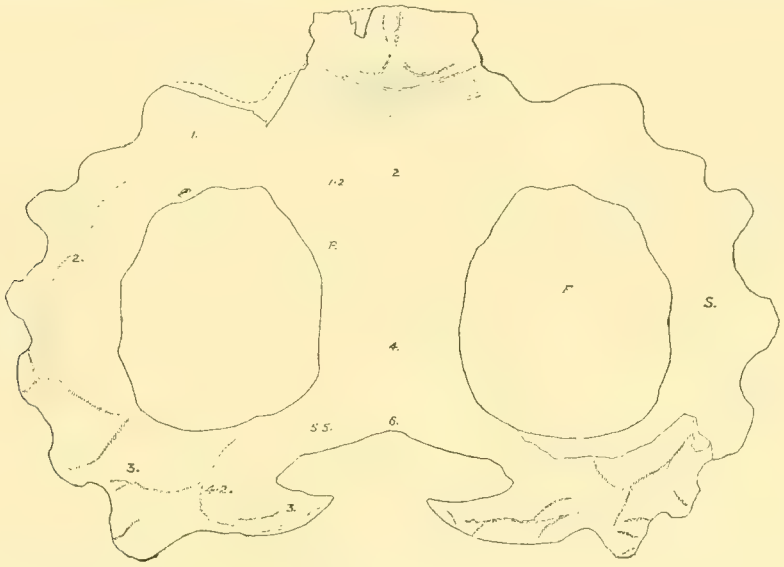


FIG. 15.—Posterior crest of *Monoclonius dawsoni*, viewed from beneath; slightly less than one-eighth natural size. The numbers give the thickness of the bone, in centimetres, at the points indicated. *P*, parietal; *S*, squamosal; *F*, fontanelle.

whilst along the sinuous curves of the sides the edge is sharp except in the emarginations where it is rounded. Vascular markings occur on both surfaces, more particularly on the peripheral projections.

Measurements.

	M.
Height of orbit	·110
Width of orbit	·095
Height of horn core	·331
Circumference at base of horn core	·343
Antero-posterior diameter of base of same	·135
Transverse diameter of base of same	·092
Diameter of occipital condyle	·060
Length of maxilla ..... approx	·350
Height of same ..... approx	·120
Long diameter of lower face of quadrate	·080
Short diameter of lower face of quadrate	·036
Posterior crest	
Extreme length from anterior end of specimen (imperfect), medially, to line touching posterior edges of specimen on either side	·616
Length on median line from anterior end to posterior border	·486
Semi-breath of specimen on curve of under surface	·470
Semi-breath of specimen horizontally	·439
Vertical drop of lateral edge of specimen below median line of under surface at mid-length	·157
Antero-posterior diameter of fontanelle	·296
Transverse diameter of fontanelle	·248
Circumference of base of left posterior spur	·172

The skull and the posterior crest were collected on Red Deer river in 1901.

With this species are provisionally associated, a scapula and coracoid, a sacrum, an ilium, a rostral bone and a predentary bone, described or referred to in the next succeeding pages.

The scapula with coracoid is figured on plate XIX., fig. 4, viewed from its inner side.

The scapula is long and narrow, slightly concave inward in the direction of its length, stout below, thinning rapidly upward, upper end terminating squarely, breadth decreasing toward mid-length, slightly expanded above, front margin thin, back margin broad below, narrowing to its mid-length then continuing thin upward. A rounded ridge extends upward, on the outer surface, diagonally across from the upper end of the glenoid cavity to the front margin continuing as a decided thickening of the front margin above.

The coracoid is broader than high, emarginated below the glenoid cavity and produced backward below, lower border turned inward, inner surface decidedly concave, back border at emargination thick, border elsewhere rather thin, rounded. Foramen traversing thickness of upper part, directed obliquely downward and outward, with an enlarged outer opening. A small foramen occurs, below the glenoid cavity, in the emargination of the posterior border. Glenoid cavity higher than broad, its curve forming almost a semicircle.

In the specimen figured, the coracoid was probably firmly united with the scapula, the suture between them, extending from the mid-height of the glenoid cavity forward, being only slightly indicated. The union of the two bones may be regarded as an evidence of age in the individual.

The left scapula and coracoid from the Red Deer river district, so similar, in most respects, to that of *Triceratops prorsus*, Marsh, as figured in the Sixteenth Report of the United States Geological Survey, differs in one important particular, viz., in having the lower border of the coracoid turned inward instead of outward.

Measurements of scapula and coracoid.

	M.
Scapula with coracoid (left). Cat. No. 506.	
Extreme length of scapula with coracoid in line with back edge of shaft	·879
Length of scapula	·711
Length across glenoid cavity	·150
Length of glenoid cavity, along curve	·204
Breadth of glenoid cavity at suture between scapula and coracoid	·078
Breadth of glenoid cavity near either end	·096
Breadth of scapula at junction with coracoid; inner surface	·175
Breadth of scapula at junction with coracoid; outer surface	·149
Breadth of scapula at upper end of glenoid cavity	·238
Breadth of scapula at mid-length	·113
Breadth of scapula at upper end	·184
Breadth of coracoid at lower end of glenoid cavity	·223
Thickness of scapula at upper end near front border	·025
Thickness on base of ridge above upper end of glenoid cavity	·060

Thickness at lower end of glenoid cavity	·060
Thickness of coracoid in concavity below foramen	·020
Width of foramen ; inner end	·014
Height of same ; inner end	·030
Width of same ; outer end	·025
Height of same ; outer end	·040

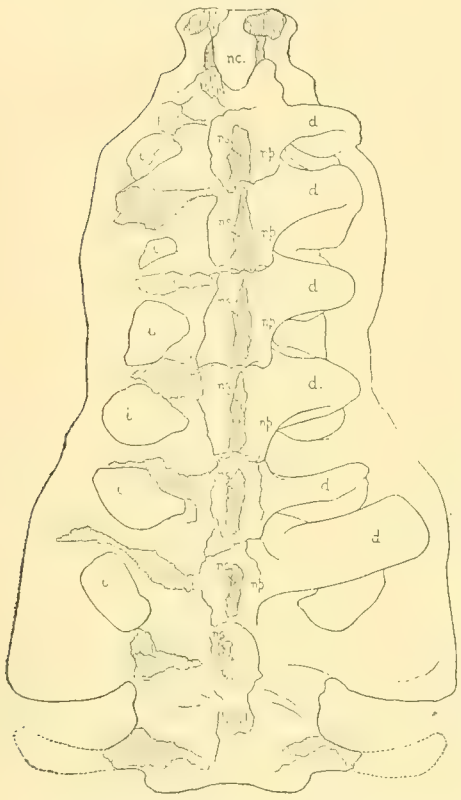


Fig. 16.—Sacrum provisionally associated with *Monoclonius dawsoni*, less than one-seventh the natural size ; superior view.

The sacrum plate XVI, figs. 1 and 2, is composed of nine coössified vertebræ, of which seven are true sacrals, the anterior one being a lumbo-sacral and the ninth a caudo-sacral. Viewed from above its general outline is seen to be somewhat triangular, the apex of the triangle pointing forward.

The vertebræ have smooth concave sides and under surfaces and are swollen, where they coalesce, so as to form a prominent angularity marking the line of union. The lower surfaces of the last five vertebræ are fluted by a deep, median, longitudinal groove that extends from the mid-length of the fifth vertebra backward to its termination in the ninth, the groove being most pronounced at the vertebral junctions. The first eight vertebræ give off seven transverse, intervertebral processes that coalesce distally so as to produce a strong bar whose outer surface forms the iliac facet. Six openings are thus left between the iliac bar, the vertebral centra and the transverse processes. The posterior vertebra gives off a simple transverse process. The junctions of the second centrum with the third, the sixth with the seventh, and the seventh with the eighth are greatly enlarged by the increased downward extension, at these points, of the neurapophyses from which the transverse processes spring ; particularly is this the case with the second and third centra. The distance of the iliac facet from the median, longitudinal line of the sacrum, dependent on the length of the transverse processes and the breadth of the centra, is much greater posteriorly than in front ; in its anterior half the facet is directed obliquely downward, possibly with some exaggeration due to distortion in the specimen. The iliac bar at its mid-length bends inward but finally reaches the first vertebra by a convex curve. Seen from the side, the iliac bar is horizontal throughout its length with the exception of an upward bend posteriorly. Diapophyses spring from the neural arches above and are connected along the length of their lower edges with the transverse processes. Proximally the superior surfaces of the diapophyses are expanded laterally so as to form a neural platform, the component parts of which are not coössified. The prezygapophyses remain distinct from the postzygapophyses.

The specimen has been somewhat crushed in a vertical direction. The diapophyses have acted as wedges and have forced apart the halves of the transverse processes near their basal origin. In figure 17, p. 62, the diapophyses are restored to their supposed

proper positions and the neural spines, whose bases are well preserved, are indicated, by dotted lines, of a length equal to that of a spine of a second sacrum of this species, measured in the field. The diapophyses are apparently not long* enough to effect a union

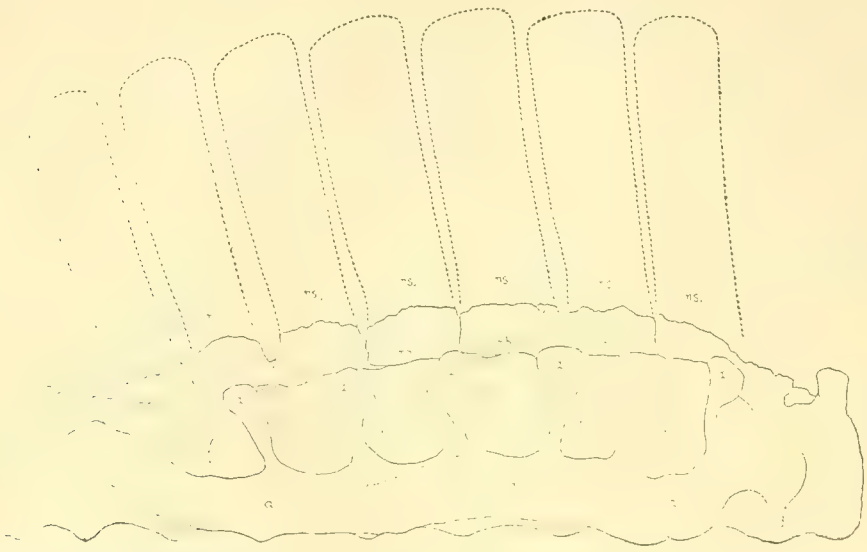


FIG. 17.—The same sacrum; right lateral aspect; about one-seventh the natural size, *a*, *a*, facet for ilium; *d*, diapophysis; *np*. neural platform; *ns*, neural spine; *i*, interspace.

with the ilium. It is possible that the concave part of the iliac facet entered into the formation of the acetabulum. The articular face of the first vertebra is slightly broader than high but in the face of the last vertebra the excess of breadth over the height is much more apparent; the anterior vertebral face is plane, the posterior one is flat vertically but concave transversely. Viewed from the side, the sacrum is moderately arched above but flat below.

Measurements of sacrum.

	M.
Extreme lenght of sacrum (30⅔ inches)	·766
Basal length of 1st vertebra	·084
" " 2nd "	·102
" " 3rd "	·085
" " 4th "	·092
" " 5th "	·086
" " 6th "	·088
" " 7th "	·088
" " 8th "	·078
" " 9th "	·063
Height of articular face of 1st vertebra	·110
Breadth of same	·123
Height of articular face of 9th vertebra	·108
Breadth of same	·150

* The apparant shortness of the diapophyses may be due in a great measure to the downward crushing to which the specimen has been subjected.

Antero-posterior diameter of base of neural spine of 2nd vertebra	·076
" " " " " " 3rd "	·081
" " " " " " 4th "	·092
" " " " " " 5th "	085
" " " " " " 6th "	·077
" " " " " " 7th "	·070
Length of iliac face along its curves	·558
" " " in a straight line	533
Breadth of same at its anterior end	·075
" " " mid-length	·056
" " " posterior end	·045
Breadth of 1st vertebra at mid-height of its concave sides	·103
" 2nd " " " "	·096
" 3rd " " " "	·079
" 4th " " " "	·072
" 5th " " " "	·073
" 6th " " " "	·088
" 7th " " " "	·150
Breadth at junction of 8th with 9th vertebra	·187
Distance from centre of neural canal to distal end of diapophysis of 2nd vertebra	·118
Distance to same of 3rd vertebra	·115
" " 4th "	·112
" " 5th "	·119
" " 6th "	·135
" " 7th "	·195

The rostral bone, figured on plate XX, and the small predentary bone (plate XIX, figs. 5 and 6) were found separately and may with some probability of correctness be referred to this species. A large ilium is figured toward the end of this report.

This species is named in honour of Dr. George M. Dawson, C.M.G., late Director of the Geological Survey of Canada.

Monoclonius canadensis. Sp. nov.

Plate XVII, figs. 3 and 4, and plate XVIII, figs. 1-7.

This species is founded on a squamosal, part of a parietal, a jugal, a supraorbital horn core, the left ramus of the lower jaw, and an anterior dorsal vertebra, with some other parts of the skull, not yet fully determined, of one individual. A right ramus of another individual is shown on plate XVIII, and a separate horn core on plate XVII.

A right mandibular ramus, referred to this species on account of its resemblance in form to the one shown above, is described farther on.

The horn core (fig. 18, page 64) rises above the orbit from the postfrontal of which it forms a part. The postfrontal unites behind, by suture, with the squamosal and below with the jugal. The orbit is oval with the longer diameter vertical, its upper curve lying close under the base of the horn core, its margins not ridged. The horn core is small, about 21·6 cent. long from the upper edge of the orbit to its summit and 22·8 cent. in circumference near the base, circular in section and solid.

Squamosal somewhat triangular in shape, flat, moderately thin, its outer edge smooth, rounded, wavy in outline so as to produce six minor convex curves, shorter and more pronounced near the front. Its outer front edge is deeply emarginated, with a shallower concavity limiting the outer termination of the jugal suture (see figure 18),

FIG. 18.—*Monoclonius canadensis*; part of the skull from the right lateral aspect; one-eighth natural size. *fp*, postfrontal; *h*, horn core; *o*, orbit; *s*, squamosal; *p*, right lateral extension from parietal; *j*, jugal; *l*, lower jaw.

inside of which is the suture for the union with the postfrontal. The inner border is slightly concave. The lower surface near and parallel to the inner posterior end is broadly and shallowly grooved for the reception of a long, slender bone, triangular in section, that projects backward and inward, its outer edge continuing the curve of the squamosal. Probably this slender bone represents the anterior end of a forwardly bent, side extension of the parietal, such as occurs in the species *Monoclonius belli*, in which case a fontanelle of moderate size might be expected on the inner side of the squamosal.

In figure 18 the underlying bone (imperfect posteriorly) is indicated by a dotted outline under the squamosal beyond which it projects; its outer free edge shows a round edged convexity in continuation of the sinuosities of the squamosal. The proximal inner margin of the squamosal is bent at right angles to the plane in which the remainder of the bone lies and its under surface is deeply excavated in its inner front part for some distance back from the postfrontal suture.

Measurements of squamosal, &c.

	M.
Length on curve of outer border	·576
Length on curve of inner border	·573
Length from posterior end to centre of front margin	·533
Breadth across front margin	·355
Thickness near outer border, at mid-length	·028

Thickness near inner border, at mid-length	·038
Length of bone underlying the squamosal (imperfect)	·502
Breadth of same at mid-length	·064
Greatest thickness at mid-length	·030

With the parts of the head, shown in fig. 18, was also found an anterior dorsal vertebra (fig. 19), of rather small size. The faces of the centrum of this vertebra are slightly concave.

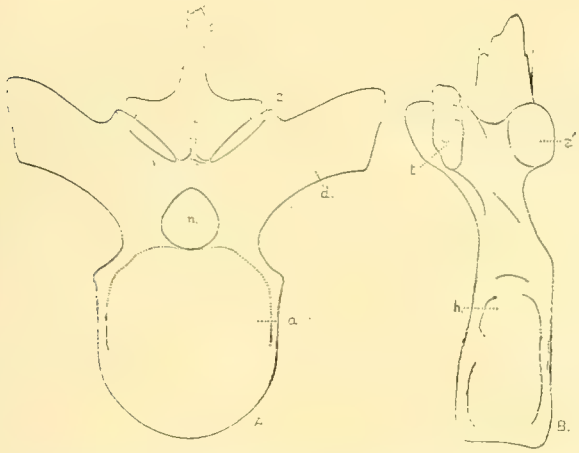


FIG. 19.—Anterior dorsal vertebra of *Monoclonius canadensis*, one-fourth the natural size. A, front view; B, left side view; *a*, anterior face of centrum; *d*, diapophysis; *h*, facet for head of rib; *n*, neural canal; *s*, neural spine; *t*, facet for tubercle of rib; *z*, prezygapophysis; *z'*, postzygapophysis.

Next following is the description of a right mandibular ramus, found separately in 1897, but agreeing in size with the one depicted in fig. 18.

Ramus of lower jaw (right). Cat. No. 284.

Ramus of lower jaw (plate XVIII, figs. 1 and 2) stout, with an inward bend at mid-length, low and thick behind, elevated and laterally compressed in front where the inner surface is shallowly concave. Excavated posteriorly below for nearly one-third of its length, the excavation extending upward along the back surface of the coronoid process, and anteriorly as the mandibular canal leading forward to the mandibular groove in the lower border. The dentary canal, between the outer alveolar wall and the outer surface, enters from the upper and anterior part of the excavation by a large opening. Coronoid process stout, upright, hooked forward and flattened laterally above, its outer, upper surface rugosely striated. A broad, low ridge, least defined toward the centre, runs at about mid-heigth, along the outer side, the surface, in a general way, above and below, retreating obliquely inward. The dental chamber, straight, starting at a low level behind, inclined strongly upward and slightly outward toward the front, its lower edge making an angle of about 20° with the lower border. Alveolar grooves in outer wall of dental chamber, deeply impressed toward their upper ends by a second series of groove terminations, an evidence of two roots in the teeth, belonging to this jaw, such as are characteristic of some of the species of the *Ceratopsidæ* (*Agathaumidæ*). Height of dental chamber much reduced forward. A number of large foramina present in the outer surface. Front border, as viewed from the side, sinuous, rugose for its union with the predentary bone. Twenty-three alveolar grooves are present in the dental chamber (imperfect posteriorly) of the specimen figured. A small symphyseal surface is present in the front, lower border.

Measurements of ramus of lower jaw.

	M.
Extreme length at mid-height	·398
Depth at mid-length	·116
Distance from upper border, a little in advance of front end of dental chamber, to lower posterior border of symphyseal surface	·137
Height of facet for articulation of predentary bone	·096
Distance from top of coronoid process to lower border	·193

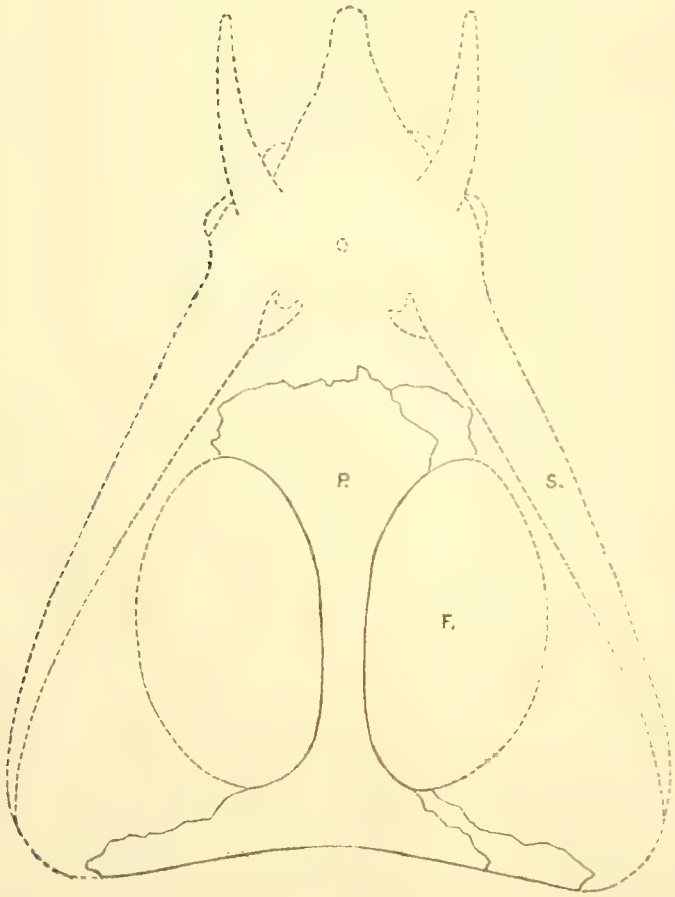
Breadth of coronoid process from point of anterior hook backward	·097
Thickness at centre of upper coronoidal expansion	·024
Thickness of coronoid process at its mid-height	·038
Antero-posterior diameter of symphyseal surface	·055
Height of same	·025
Width of larger alveolar grooves at middle of dental chamber	·009
Six grooves in a space of	·072
Height of grooves, from their base to upper edge of outer alveolar wall, at middle of dental chamber	·028
Height of same anteriorly	·044

A maxillary bone (not figured) with teeth that are double fanged, is referred to this species. One of the teeth is shown on plate XVIII, figs. 3 and 4.

A separate tooth, presumably from the lower jaw, is also figured on plate XVIII. It was found separately, but on account of its having two roots, agreeing thus with the evidence of the alveolar grooves of the mandibular ramus just described, it is likewise referred to *M. canadensis*.

Monoclonius belli. Sp. nov.

Plate XX, figs. 1 and 2.



The bone, figured on the above plate, is interpreted as representing the coalesced parietals of the posterior crest of an undescribed species of *Monoclonius*, probably ancestral to such later forms as *Torosaurus latus* and *T. gladius* of Marsh, from the Laramie, of Wyoming.

To facilitate an understanding of the view held as to the position the parietals probably occupied relative to other bones of the head, a drawing of the bone, has been applied to the figure, slightly modified, of the skull of *T. gladius*, as given by Marsh, in the Sixteenth Annual Report of the United States Geological Survey.

Fig. 20.—Posterior crest of *Monoclonius belli*, from Red Deer river; one-ninth natural size. The dotted lines are from a drawing of the head of *T. gladius*, Marsh, as seen from above. *P*, Parietal; *S*, Squamosal; *F*, Fontanelle.

The parietal element from Red Deer river is symmetrical, T-shaped, wth a sub-cylindrical shaft expanding rapidly both in front and behind. Anteriorly the expansion is concave below, strengthened above by a median, rounded ridge in continuation of the central shaft, and thinning out laterally. Posteriorly the shaft divides, nearly at right angles to itself, to either side, so as to form a strong transverse bar slightly concave at mid-length above and convex below, thin at its front edge and thickest behind. The posterior border is angularly rounded.

The space on either side of the shaft represents the inner halves of the supra-temporal fontanelles. The bone missing from the specimen would complete the outer border of the fontanelles and effect a union with the inner margins of the squamosals. The lower face of the anterior expansion, on either side of the median line, is striated by distinct furrows that follow down the lower lateral sides of the shaft, as deep grooves, and curve outward on to the transverse bar. The anterior upper surface also exhibits similar grooves that do not, however, pass beyond the mid-length of the shaft.

The parietal, imperfect at its anterior end, is about one-third the size of that of *T. gladius* and would probably represent a proportionately smaller animal, an earlier and more generalized form of the genus with larger fontanelles than its later Laramie successors.

Measurements of parietal bone.

	M.
Extreme length of specimen (imperfect anteriorly) along median line	·584
Breadth of front expansion from median line to left edge of specimen	·173
Breadth of posterior border from median line to left edge of specimen	·305
Circumference of shaft at mid-length	·180
Breadth of same at mid-length	·065
Thickness of same at mid-length	·053
Thickness of anterior expansion at centre on median line	·041
Thickness at anterior end of specimen on median line	·018
Thickness on median line midway between posterior border and narrowest part of shaft	·035
Antero-posterior diameter of fontanelles	·416

Belly River series, Red Deer river, 1898.

This species is dedicated to Dr. Robert Bell, the administrative head of the Geological Survey.

* Amer. Jour. Sci. and Arts. 1891, vol. xlii., p. 266. Ibid, 1892, vol. xliii., p. 81, plate ii.

COMPARATIVE TABLE OF HORN CORES, &c., OF SPECIES OF MONOCLONIUS AND POLYONAX.

	Monoclonius crassus.	Polyonax mortuarius.	Monoclonius recurvicornis.	Monoclonius sphenoceras.	Monoclonius dawsoni.	Monoclonius canadensis.	Monoclonius belli.
Nasal horn.			Robust, depressed, curved forward.	Long, straight laterally compressed, upright.	Slender, long, very slightly curved backward.		
Orbital horn.	Very small, upright, flattened on outer side.	Supposed horns long and slender.	Robust, short, flattened on outer side, upright.		None	Moderate size, slender, curved obliquely inward and backward; base overhangs orbit.	
Squamosal.	Narrow, and thin with scalloped border; coössified with parietals.				Thin, with scalloped border; fewer emarginations than in *M. crassus.*	Plate like; lower posterior border slightly scalloped.	
Parietals.	Thin, expanded posteriorly and anteriorly; smooth behind.				Thickened posteriorly; with two incurved hooks on back border.	Known only from the posterior right lateral extension partly underlying squamosal.	Reversed T-shaped, shaft subcylindrical, anterior expansion thin, posterior expansion bar-like.
Teeth.	? Single fanged.				? Single fanged.	Double fanged.	

Stegoceras. Gen. nov.

Stegoceras validus. Sp. nov.

Plate XXI, figs. 1–5.

The two symmetrical, compact bones, represented on plate XXI, were found separately. The lower portions of their sides, as well as their ends, consist of sutural surfaces, indicating that other bones were firmly united to them and completely surrounded them. A transverse suture divides each almost equally into an anterior and a posterior half. On the lower surface there is evidence of a line of coalescence in a longitudinal direction and extending from end to end. The upper surface of each specimen is dome shaped.

In the larger specimen the anterior end is produced forward and is slightly elevated terminating in two projections; the surface is here distinctly nodose. In the lateral, posterior, upper surface a similar rugosity is apparent. The surface of the central convexity is smooth.

In the smaller specimen the upper surface is smooth and pitted throughout. It is trilobed posteriorly and is not produced forward in front where, however, two small nodes occur, one on each side of the median line.

The structure of the lower surface is marked by a number of smooth, concave areas, as represented in the reproductions, from photographs of the specimens, in figs. 2 and 5 of plate XXI.

It is probable that these bones were situated in the median line of the head, in advance of the nasals. They may have belonged to a species of dinosaur not otherwise represented in the collections from Red Deer river and, judging from the difference in shape of the two specimens, more than one species may be indicated. Marsh in his figure of the head of *Triceratops serratus** shows a nasal horn core (divided both transversely and longitudinally by sutures) that may correspond to the specimens from Red Deer river.

A third specimen, similar to the anterior half of the larger of the two bones was collected in 1901. It has separated from its posterior half along the line of the transverse suture.

For these bones the name *Stegoceras validus* is proposed with the hope that future discoveries may aid in a clearer understanding of their affinities.

Belly River series, Red Deer river. 1898, 1901.

TRACHODONTIDÆ.

Trachodon, Leidy.

Trachodon (Pteropelyx) selwyni. Sp. nov.

Plate III, figs. 2 and 3.

This species is established principally on the evidence of teeth, of which a number from the lower jaw are shown on plate III. The teeth follow each other, quincuncially in the usual *Trachodont* manner, three or four occurring in the vertical series, but seven or eight can be counted obliquely. They replace each other from the inside and appear in the grinding surface in two or three functional rows. When three teeth belonging to the same vertical row are in use in the grinding surface at the same time (see fig. 3 of plate III), the outer one is generally worn down to the root and the stump is ready to fall out, the middle one is about half worn down, whilst the inner one is either just coming into use or is only slightly worn.

The teeth of this species differ from those of *T. mirabilis*, Leidy, in being rounded oval above, instead of terminating in a point. They are smooth in both species. A few

*Amer. Jour. Sci. and Arts. vol. XLIII, pl. III, fig. 4. 1892.

minute, obliquely transverse striæ are observed on the margins of the teeth of *T. selwyni* but they are practically smooth, the marginal, or border sculpture characteristic of the teeth of the species described in the next following pages being absent.

A few, very large mandibular rami without teeth, one of which is represented in fig. 24, A, are supposed to belong to this species.

A femur, provisionally associated with *T. selwyni*, was secured during the summer of 1901. It measured about 1·425 M. (56 inches) in length when perfect. It is ·585 M. and ·508 M. in circumference above and below the third trochanter respectively, and indicates the size attained by some of the herbivorous dinosaurs during Mid-Cretaceous times. For the purpose of comparison a reduced figure of this immense bone is given with a similarly reduced drawing of the femur of *Iguanodon mantelli*, Owen, from the Wealden of Filgate Forest, Sussex, England (see fig. 21).

Fig. 22.—Diagrammatic representation of the growth of teeth in *Trachodon*. A, transverse section of the mandibular ramus; B, transverse section of the maxilla. The heavy lines represent the enamelled surfaces of the crowns of the teeth. *c*, grinding surfaces; *d*, much worn teeth; *e*, partly worn teeth; *f*, successional teeth in the same vertical row with *d* and *e*; *g*, foramen; *h*, mandibular groove; *i*, inner wall of dental chamber.

Fig. 21.—*A*, front view of right femur of *Trachodon selwyni*, from Red Deer river; *B*, front view of right femur of *Iguanodon mantelli*, from the Wealden of England One-sixteenth natural size. *h*, head; *t*, great trochanter; *m*, third trochanter; *c*, inner condyle.

Fig. 22, illustrates, in a diagrammatic manner, the general mode of succession of teeth in the genus *Trachodon*. The teeth are represented as they appear in transverse sections of the jaws, the heavy lines indicating the keeled enamelled crowns of the teeth. Thus although in both the upper and lower jaws the teeth replace each other from the inner side, yet the enamelled surface of the crown of the teeth are on the inner side in the lower jaw but on the outer side in the maxilla.

With this species is connected the name of Dr. Alfred R. C. Selwyn, C.M.G., for many years, prior to 1894, Director of the Geological Survey.

Trachodon (Pteropelyx) marginatus. Sp. nov.

Plate III, fig. 1, plate IV, figs. 1, 5 and 6, and plates V, VI, VII, VIII, IX and X.

Excellently preserved remains, of a large herbivorous dinosaur, met with in abundance in the Red Deer river district, are referred to the above species. Although the various bones of the skeleton were generally found distributed, a number were discovered associated with each other, the remains of one individual. These consisted of the humerus, ulna and radius of the left fore limb, a metatarsal and phalanges of the pes, the zygapophyses of cervical vertebræ, ribs, fragments of teeth, broken ossified tendons and impressions of the integument. The species is represented further by disassociated femora, tibiæ, metacarpals and phalanges of the manus, rami of the lower jaw and maxillæ with remarkably well preserved teeth in place, dorsal and caudal vertebræ, a pubic bone, ischia, ilia, chevron bones and numerous teeth as well as other remains probably referable to the same species.

Of the bones, of one individual, found in association, the humerus with the ulna and radius are figured on plates VI and VII.

The humerus, figs. 1 and 2, has a prominent radial crest that extends, from the external tuberosity above to slightly more than half way down the shaft externally and is roughly striated at its lower end for the attachment of the deltoid muscle. The head is small and is supported below by a strong rounded ridge. The proximal end, seen from above, is roughly triangular in shape, the front face broadly excavated with conspicuously concave surfaces on either side of the head behind that continue forward to meet the inner and outer tuberosities. The condyles are separated by a deep depression behind, that extends up the shaft for a short distance; in front they are not so conspicuously divided.

An archaic feature is expressed in the great downward extension and conspicuous angularity of the radial crest. In comparing this humerus with that of *Hadrosaurus Foulkii*,* Leidy, from the Cretaceous of the east, a form allied to this species, a marked difference is noticeable in their proportions.

Measurements of humerus.

	M.
Extreme length (27 inches)	·683
Breadth at lower end of radial crest	·165
Circumference midway between lower end of radial crest and distal end	·265
Breadth across head and outer tuberosity	·140
" " inner tuberosity	·130
Breadth across inner and outer tuberosities	·145
Breadth of outer condyle	·100
Breadth of inner condyle (imperfect)	·080
Thickness at centre of condyles	·092
Thickness of radial crest near lower end	·034

*1865. Cretaceous Reptiles of the United States, p. 76, pl. xiv, figs. 1, 2, 3 and 4. Smithsonian Contr. to Knowledge, vol. xiv.

The ulna and radius, belonging to the same fore limb as the humerus, are figured as they were found,

The ulna has a strongly developed olecranon process terminating its expanded proximal end which is concave on three sides so as to be subtriangular in section. From the middle of its shaft downward, it increases in size very little.

The radius is a comparatively slender bone but terminates below in a carpal articulating surface slightly larger than that of the distal end of the ulna.

Measurements of ulna and radius.

	M.
Extreme length of ulna (28 inches)	·708
Circumference at middle of shaft	·190
Greatest breadth across coronoid process	·145
Greatest thickness at proximal end	·094
Greatest diameter of carpal end	·074
Shortest diameter of carpal end	·057
Extreme length of radius (25 inches)	·632
Circumference at middle of shaft	·155
Long diameter of head	·086
Short diameter of head	·054
Long diameter of carpal end	·087
Short diameter of carpal end	·050

The right femur, plate VIII, provisionally associated with *T. marginatus*, is interesting in many particulars, notably, its slenderness, the prominence of the head, the backward extension of the condyles and the marked development of the third trochanter. The inner condyle is larger than the outer one; they are both, viewed from the side, broadly rounded posteriorly and pointed in front. From the great trochanter, a prominent ridge extends downward, for some distance on the outer front face of the bone.

Measurements of femur.

	M.
Length from top of trochanter to bottom of outer condyle	1·1825
Length from top of head to bottom of inner condyle	1·1698
Breadth of upper extremity	·2464
Breadth of lower extremity	·2497
Transverse diameter at middle of shaft	·145
Antero-posterior diameter at middle of shaft	·134
Circumference below third trochanter	·4048
Circumference above third trochanter	·4774
Antero-posterior diameter of head (imperfect)	·127
Antero-posterior diameter of trochanter	·209
Antero-posterior diameter of inner condyle	·300
Length of third trochanter	·377
Height at centre of third trochanter	·047

A comparison of this femur with that of *Hadrosaurus foulkii*, Leidy reveals a great similarity in their general proportions. If anything, the Red Deer river specimen is more slender but otherwise there are no very marked differences.

The tibia (plate IX, figs. 1 and 2), was probably not as long as the femur but was a decidedly robust bone. Unfortunately no specimens were secured associated with femora that might be supposed to belong to the same individual.

Of the two right tibiæ figured on plate IX (provisionally referred to T. marginatus), the one on the right, seen from behind, is considerably crushed so as to exaggerate the breadth of the proximal end; the other specimen is remarkably well preserved.

This bone of the leg, cylindrical at mid-length, expands rapidly toward either end. The longer axis of the distal end is nearly at right angles to that of the proximal end. Viewed from behind, the proximal end is seen to be broadly concave, the outer side consisting of a backwardly directed flange. On the inner side the head is divided into two parts by a deep furrow.

Measurements of tibia.

	M.
Length of tibia externally	1·018
Length in front	·980
Circumference at narrowest part of shaft, just below the middle	·379
Breadth of upper extremity	·272
Diameter of middle of head antero-posteriorly	·2024
Breadth of tarsal extremity	·337
Diameter at middle of tarsal surface	·123

Ramus of lower jaw, plates III and IV, long and narrow, with teeth occupying a deep, narrow chamber or magazine in the posterior two-thirds of the length. Coronoid process high, rising abruptly from the outer side of the posterior end; laterally compressed above, deeply excavated below posteriorly. An edentulous prolongation in front curves obliquely downward and inward with a symphyseal surface at the inner forward end. Upper and lower borders nearly parallel. Outer wall of dental chamber thick and strong, with shallow, vertical, alveolar grooves occupying its inner side. Inner wall, very thin, averaging about 2 mm. in thickness, without alveolar grooves proper; seldom preserved. Coronoid process below, produced backward externally as a thin plate of bone continuous with the outer surface of the jaw; on its inner side it unites with the outer alveolar wall in advance of the posterior end of the dental chamber. Dentary canal leading from the upper part of the posterior cavity forward between the outer surface of the jaw and the dental chamber. Mandibular groove passing forward under the lower border of the chamber. A row of foramina occurs on the inner side, one foramen at the base of each vertical series of teeth. A number of foramina also present on the outer suface. Teeth replaced from within, their keeled, enamelled surfaces of the crown inside; occurring in a vertical series of three or four near the middle of the jaw with two or three of a series in use in the grinding surface at the same time. Their lateral margins decorated with small, rounded projections from near the apex downward to where the crown begins to narrow again.

Measurements of left ramus of lower jaw.

	M.
Extreme length	·630
Depth at middle of magazine	·095
Width at base of magazine	·034

Length of magazine	·400
Depth of same at its mid-length	·088
Width through magazine at middle of magazine	·068
Elevation of coronoid process above lower border	·232
Elevation of coronoid process above upper border	·158
Antero-posterior diameter of coronoid process above	·080
Transverse diameter of coronoid process above	·015
Thickness of inner alveolar wall	·002
Forty-six alveolar grooves.	
Diameter of dental foramina (largest)	·065
Diameter of dental foramina at ends of series	·040
Elevation of grinding surface of teeth above edge of outer wall	·075
Distance from front of magazine to anterior end of symphyseal surface	·182

Maxilla, plate V, robust, high at the centre, sloping downward toward either end, the dental chamber occupying nearly the whole of its length. Seen from above, the posterior half slopes obliquely forward and outward, while the reverse is the case in front; at the extreme anterior end there is a limited slope inclined obliquely outward. Also, viewed from above, the posterior half is straight and broader than the front half which narrows to a rounded, outwardly turned point. Inner surface rather flat. Outer surface with a rounded ridge running horizontally from the posterior end to meet the facet for the articulation of the anterior end of the jugal. On the inner, upper side behind mid-length, a facet, probably for the palatine, is present. Teeth replacing each other from the inner side, apparently not more than two of a series in use in the grinding surface at the same time; the carinated, enamelled faces of the crowns facing outward. A row of foramina, similar to that of the lower jaw, conspicious in the upper part of the inner side. Several large foramina occur in the anterior half of the outer side.

Measurements of right maxilla

	M.
Extreme length	·360
Extreme depth of same (imperfect above)	·117
Length of dental series	·316
Thickness of maxilla at mid length	·078
Distance apart of lower edges of alveolar walls at mid-length	·025
Distance apart of same near anterior end	·016
Distance apart of same near posterior end	·015
Distance of row of foramina (forty in number) above edge of inner alveolar wall at centre	·055
Projection of outer edge of grinding surface of teeth below edge of outer alveolar wall at centre	·019
Projection of inner edge of same below edge of inner alveolar wall at centre	·007
Average horizontal diameter of foramina in inner alveolar wall	·047

Pubis, plate X, fig. 1 (provisionally associated with *T. marginatus*), produced forward into a broad, thin, transversely compressed, spatulate expansion that is slightly concave on its outer surface. Posteriorly a slender postpubic process, springing from a point inside and in advance of the base of the pedestal bearing the ischiac facet, is directed backward on the lower border of the ischium with which it effects a ligamental union.

Iliac facet small, separated from the ischiac facet by a wide, concave, acetabular emargination that forms about one-third of the whole acetabular border.

Measurements of pubis.

	M.
Length of acetabular border along curve	·235
Distance from centre of ischiac facet to centre of iliac facet	·205
Breadth at narrowest part of anterior expansion	·092
Thickness at centre of narrowest part	·027
Breadth of specimen anteriorly (imperfect)	·174
Circumference of base of postpubic process	·092
Vertical diameter of ischiac facet	·045
Greatest thickness slightly in advance of acetabular border	·022
Greatest thickness at centre of anterior end (imperfect) of specimen	·018
Length of specimen from ischiac facet to anterior end	·485
Estimated length of pubis, when perfect, from anterior end to posterior end of postpubic process (37 inches)	·940

Ischium long, plate X, fig. 2 (provisionally associated with *T. marginatus*), laterally compressed, broadly expanded proximally and ending distally in a foot-shaped extremity pointing downward. Shaft almost straight, its upper edge curving concavely and broadly upward to meet the iliac facet. Upper expanded part very thin, plate-like, thickened abruptly, on either side of the thin, concave edge of the acetabular border, to form well developed iliac and pubic facets. The surfaces of the facets very rugose. A narrow postpubic facet extends, downward and backward at right angles to the pubic facet along the lower front border of the proximal end. Below this facet and separated from it by a concavity in the thin margin is a flange of bone for the further support of the postpubis. Inner surface of distal half, striated longitudinally for a ligamental union with its mate of the opposite side.

Measurements of ischium.

	M.
Extreme length from iliac facet	1·050
Distance from upper end of iliac facet to lower end of pubic facet	·332
Length of acetabular border measured on concavity	·140
Length of iliac facet	·135
Breadth of same	·060
Length of pubic facet	·040
Breadth of same	·020
Length of postpubic facet	·122
Breadth of same	·013
Circumference at mid-length	·162
Breadth of expanded distal end	·0217
Thickness of lower part of same	·070
Thickness of upper part of same	·040
Thickness of proximal expansion at centre	·016

A number of ilia, representing different types of herbivorous dinosaurs, are included in the collections. In fig. 23, three of these are shown. The upper one, A, is of the *Monoclonius* type and is arbitrarily associated with *M. dawsoni*, another, B, is referred to

Trachodon marginatus (provisionally), whilst the lower one, C, *Stegosauroid* in its character, may belong to *Stereocephalus tutus*.

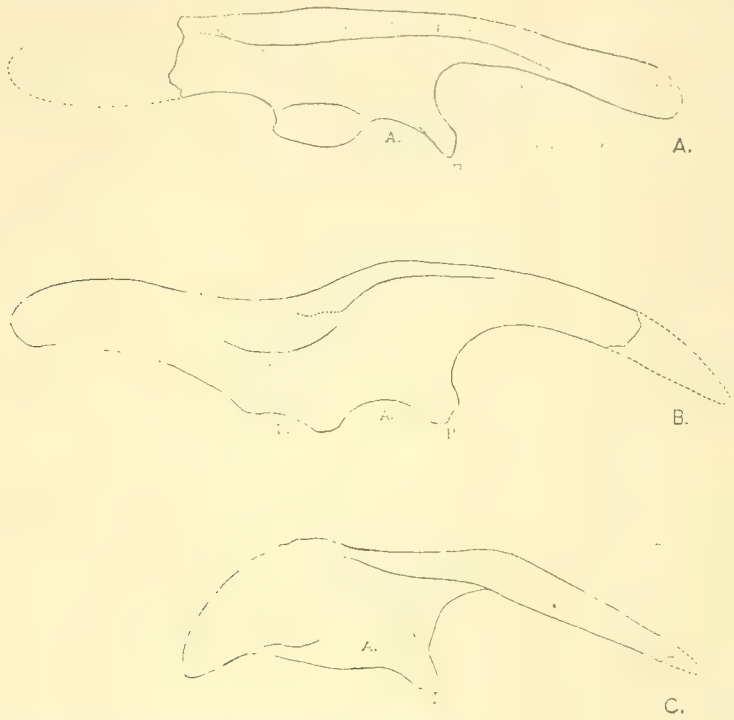


FIG. 23.—Ilia of herbivorous dinosaurs from Red Deer river; one-twelfth the natural size. A, right ilium of *Monoclonius dawsoni*; B, the same of *Trachodon marginatus*; C, that of *Stereocephalus tutus*. *A*, acetabulum; *P*, facet for pubic bone; *Is*, facet for ischium.

TRACHODON (PTEROPELYX) ALTIDENS. Sp. nov.

Plate IV, figs. 2, 3 and 4.

A left maxilla, with the teeth preserved, reveals a hitherto undescribed species of *Trachodon*. The teeth are distinctly narrow in proportion to their length and are beautifully marked, for a short distance above the apex of the crown, on the raised edges of the outer enamelled face by a few, obliquely placed, transversely elongated embossments, which decrease in size gradually, from the apex of the tooth upward until they become inconspicuous as a few marginal denticles or projections. The name of the species is suggested by the height of the teeth relative to their breadth and the distance they project beyond the alveolar border.

The maxilla indicates an animal of comparatively small size and slender proportions. Three rows of teeth, more generally two, were in use in the grinding surface at the same time, with at least two or three series of successional teeth following, to replace those in use from the inside, the stumps of the old teeth falling out on the outside of the jaw. In fig. 3, the mode of succession of the teeth downward is shown, the bone having been removed for a short distance from the anterior end of the specimen. About one-fifth of

the maxilla is missing anteriorly, as well as a considerable part of the superior border above the row of foramina. A prominent, overhanging ridge, runs forward, on the outer side, from the posterior end, forming the outer and lower border of the facet for the front part of the jugal. A noticeable feature is the distance the teeth project beyond the borders of the alveolar walls. Four neuro-vascular foramina are conspicuous in the outer wall in front of the ridge just mentioned. The enamelled surface of the crown of each tooth bears a strong median carination. The teeth from which the apices have been removed by use are quite smooth and do not show the characteristic border markings.

COMPARATIVE TABLE OF TEETH OF SPECIES OF TRACHODON AND PTEROPELYX.

Trachodon mirabilis, Leidy.	Teeth pointed above; margins smooth.
Trachodon (*Pteropelyx*) *selwyni*, Lambe.	Teeth rounded oval above; margins smooth or with the faintest indications of oblique transverse striæ. Fig. 2, plate III.
Trachodon (*Pteropelyx*) *marginatus*, Lambe.	Teeth rounded above; with a marginal sculpture. Figs. 5 and 6, plate IV.
Pteropelyx grallipes, Cope.	Teeth rounded above; with a border sculpture. Fig. 7, plate IV.
Trachodon (*Pteropelyx*) *altidens*, Lambe.	Teeth of small size, long in proportion to the breadth, and pointed above; with a border sculpture near the apex. Fig. 4, plate IV.

A large series of rami of lower jaws of species of *Trachodon* were collected in the Red Deer river district. Unfortunately in most of the specimens the teeth are missing, making their specific identification somewhat conjectural. In fig. 24, three of the rami are figured to show size and form.

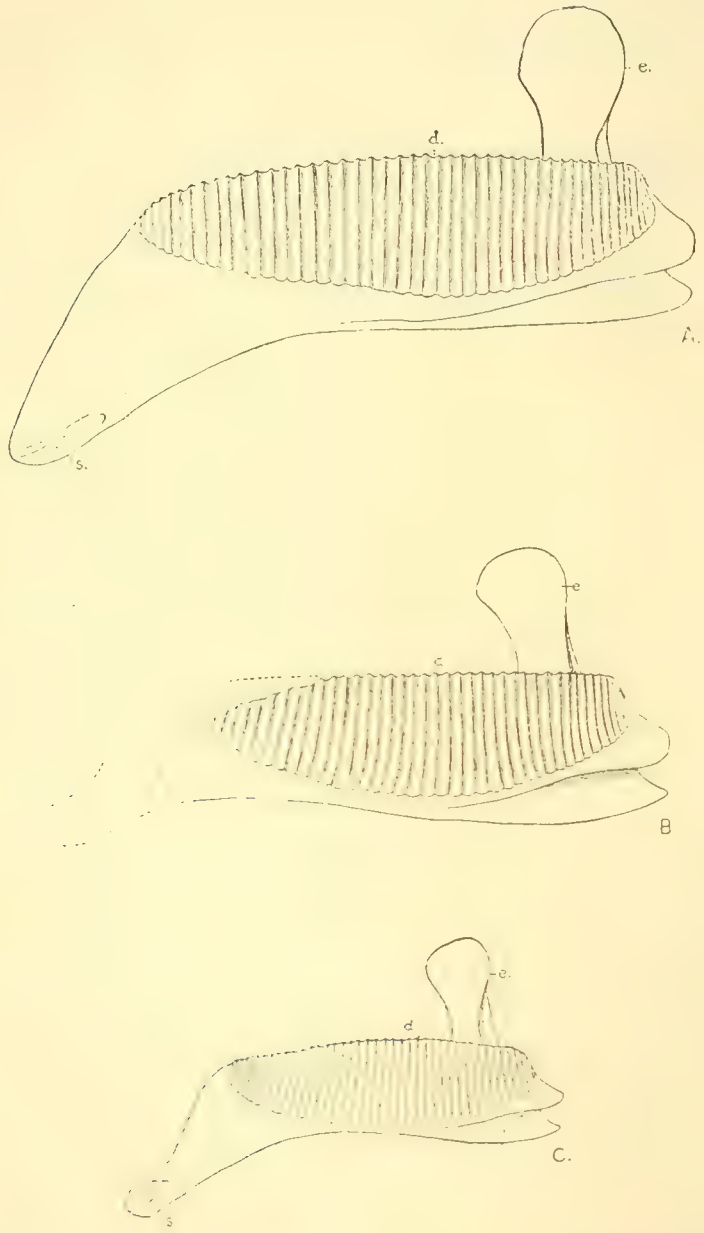


FIG. 24. Right mandibular rami of species of *Trachodon* from Red Deer river, A, ramus of lower jaw of *T. selwyni*; B and C, rami probably referable to *T. marginatus*. *d*, alveolar grooves from which the teeth have fallen; e, coronoid process; *s*, symphyseal surface. One-sixth the natural size.

MAMMALIA.

MULTITUBERCULATA.

PLAGIAULACIDÆ.

Ptilodus, Cope.

Ptilodus primævus. Sp. nov.

Plate XV, figs. 13 and 14.

The specimen on which this species is based consists of an imperfect right mandibular ramus in which the fourth premolar and the first molar are preserved. The fracture in front exposes the large anterior root of the premolar and the small posterior root is seen from the outer side. The lower front border of the crown of the premolar is slightly excavated apparently for the accommodation of the posterior edge of a very small, closely fitting third premolar. The socket for the base of the root of the incisor is seen on the inner side and indicates a tooth of comparatively robust proportions. Behind the first molar, the socket of the second molar is preserved, which, judging from its size, held a tooth considerably smaller than the first molar.

The characters of the teeth are as follows :—Fourth premolar with eleven serrations on its edge ; on its inner side, five complete grooves preceded by three half grooves ; on its outer side, five complete grooves preceded by one half groove. First molar with four tubercles on its inner side and six tubercles on the outer side.

Ptilodus primævus is especially interesting on account of the small number of grooves on the large cutting fourth premolar (approching the genus *Meniscoëssus* in this respect) and the slightly backward curve of the tubercles on the outer side of the first molar, also suggestive of *Meniscoëssus.*

In the figures of the type of the species, the teeth are shown as they appear in the specimen, but the first molar is evidently somewhat out of its true position of close proximity to the fourth premolar.

Belly River series, Red Deer river, 1901.

Boreodon. Gen. nov.

Boreodon matutinus. Sp. nov.

Plate XV., fig. 15.

This early type of mammal is represented by a single tooth, a premolar, having two, slightly divergent roots. The crown is in the form of a laterally compressed cone, somewhat rounded above, angular in front, evenly rounded behind, with a well defined, undulating cingulum encircling its base. A slight lateral concavity, more clearly defined within, occurs in each side of the tooth near the base of the crown in line with

the cleft between the roots. The cingulum is angular and prominent at either end, becoming rounded and broader on the sides. The crown is considerably worn on the inner side of its apex. One root only remains and it is imperfect below.

Measurements.

		M.
Length of tooth (imperfect below, worn above)		·0080
Diameter of crown	antero-posterior	·0047
	transverse	·0030
Height of crown		·0040

SYNOPSIS OF SPECIES WITH PAGE AND PLATE REFERENCES.

	Species.	Page.	Plate.
	PISCES.		
1	*Myledaphus bipartitus*, Cope.	28.	XIX.
2	*Acipenser albertensis*, Lambe.	29.	XXI.
3	*Lepidotus occidentalis*, Leidy.	29.	XIX.
4	*Rhineastes eruciferus*, Cope.	29.	
5	*Diphyodus longirostris*, Lambe.	30.	XV.
	BATRACHIA.		
6	*Scapherpeton tectum*, Cope.	31.	III.
	REPTILIA.		
7	*Cimoliasaurus magnus*, Leidy.	32.	
8	*Trionyx foveatus*, Leidy.	33.	I, and figures in text.
9	*Trionyx vagans*, Cope.	36.	I, and figure in text.
10	*Adocus lineolatus*, Cope.	38.	
11	*Adocus variolosus*, Cope.	39.	II, and figures in text.
12	*Neurankylus eximius*, Lambe.	42.	Figure in text.
13	*Baëna hatcheri*, Hay.	43.	Figures in text.
14	*Baëna antiqua*, Lambe.	44.	Figures in text.
15	*Champsosaurus annectens*, Cope.	45.	
16	*Troödon formosus*, Leidy.	47.	
17	*Crocodilus humilis*, Leidy.	47.	
18	*Bottosaurus perrugosus*, Cope.	48.	
19	*Deinodon horridus*, Leidy.	49.	
20	*Deinodon explanatus*, Cope, sp.	49.	XV.
21	*Ornithomimus altus*, Lambe.	50.	XIII, XIV, XV, and figures in text.

SYNOPSIS OF SPECIES WITH PAGE AND PLATE REFERENCES—*Continued.*

	Species.	Page.	Plate.
	REPTILIA—*Continued.*		
22	*Palæoscincus costatus*, Leidy.	53	
23	*Palæoscincus asper*, Lambe.	54	XVII.
24	*Stereocephalus tutus*, Lambe.	55	XI, XII, XXI, and figures in text.
25	*Monoclonius dawsoni*, Lambe.	57	XVI, XIX, XX, and figures in text.
26	*Monoclonius canadensis*, Lambe.	63	XVII, XVIII, and figures in text.
27	*Monoclonius belli*, Lambe.	66	XX, and figure in text.
28	*Stegoceras validus*, Lambe.	68	XXI.
29	*Trachodon* (*Pteropelyx*) *selwyni*, Lambe,	69	III, and figures in text.
30	*Trachodon* (*Pteropelyx*) *marginatus*, Lambe.	71	III—X, and figures in text.
31	*Trachodon* (*Pteropelyx*) *altidens*, Lambe.	76	IV.
	Pteropelyx grallipes, Cope.	77	IV.
	MAMMALIA.		
32	*Ptilodus primævus*, Lambe.	79	XV.
33	*Boreodon matutinus*, Lambe.	79	XV.

PLATE I.

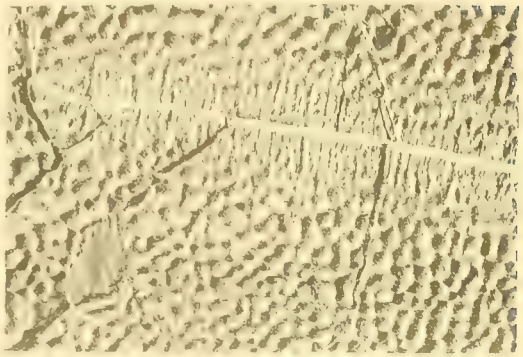
PLATE I.

Fig. 1. *Trionyx foveatus*, Leidy, upper surface of the carapace shown in figure 1, p. 34; one-half the natural size. Page 33.

Fig. 2. *Trionyx foveatus*, lower or outer surface of a right hypoplastral bone; natural size. Page 35.

Fig. 3. *Trionyx vagans*, Cope, upper surface of carapace shown on page 37, figure 3; slightly less than one-fourth natural size. Page 36.

Fig. 4. Portion of the upper surface of the same carapace, natural size; to show the sculpture.



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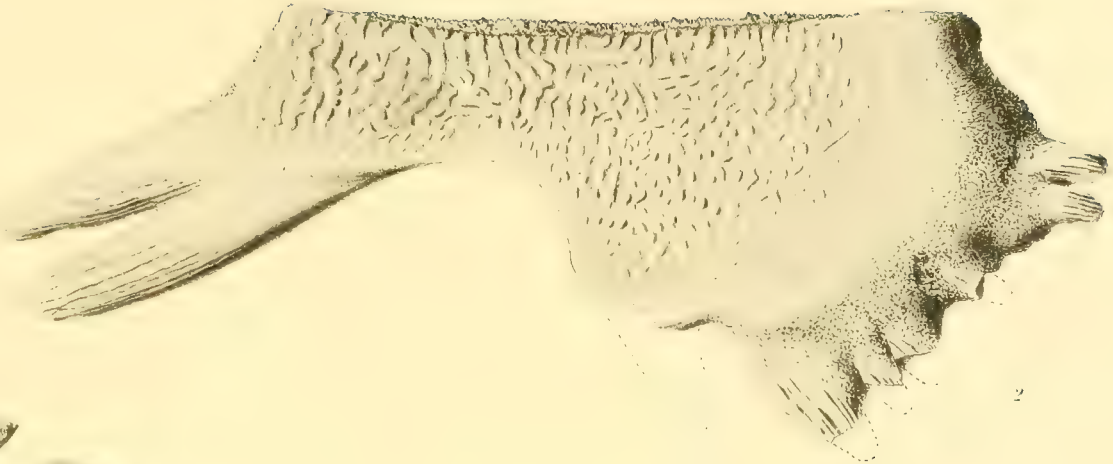

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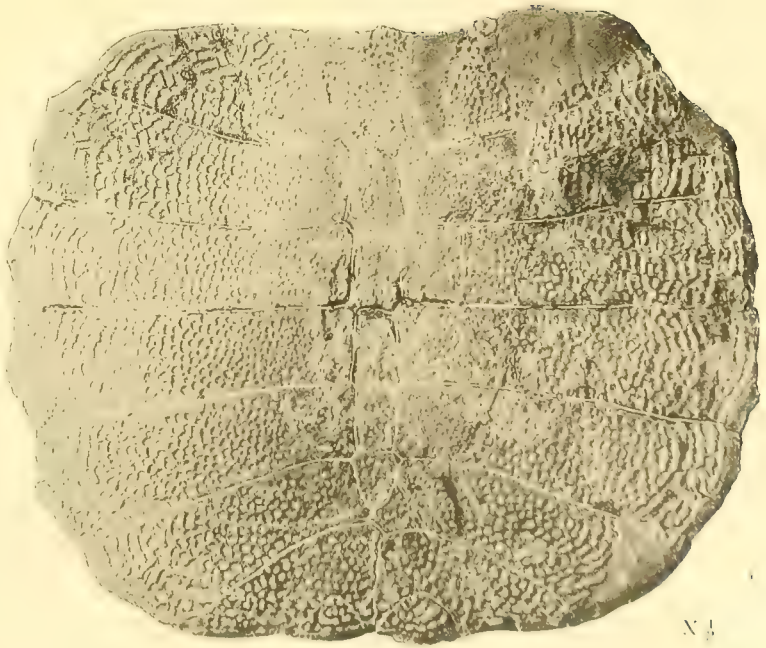


N 1

HELIOTYPE CO., BOSTON.

PLATE II.

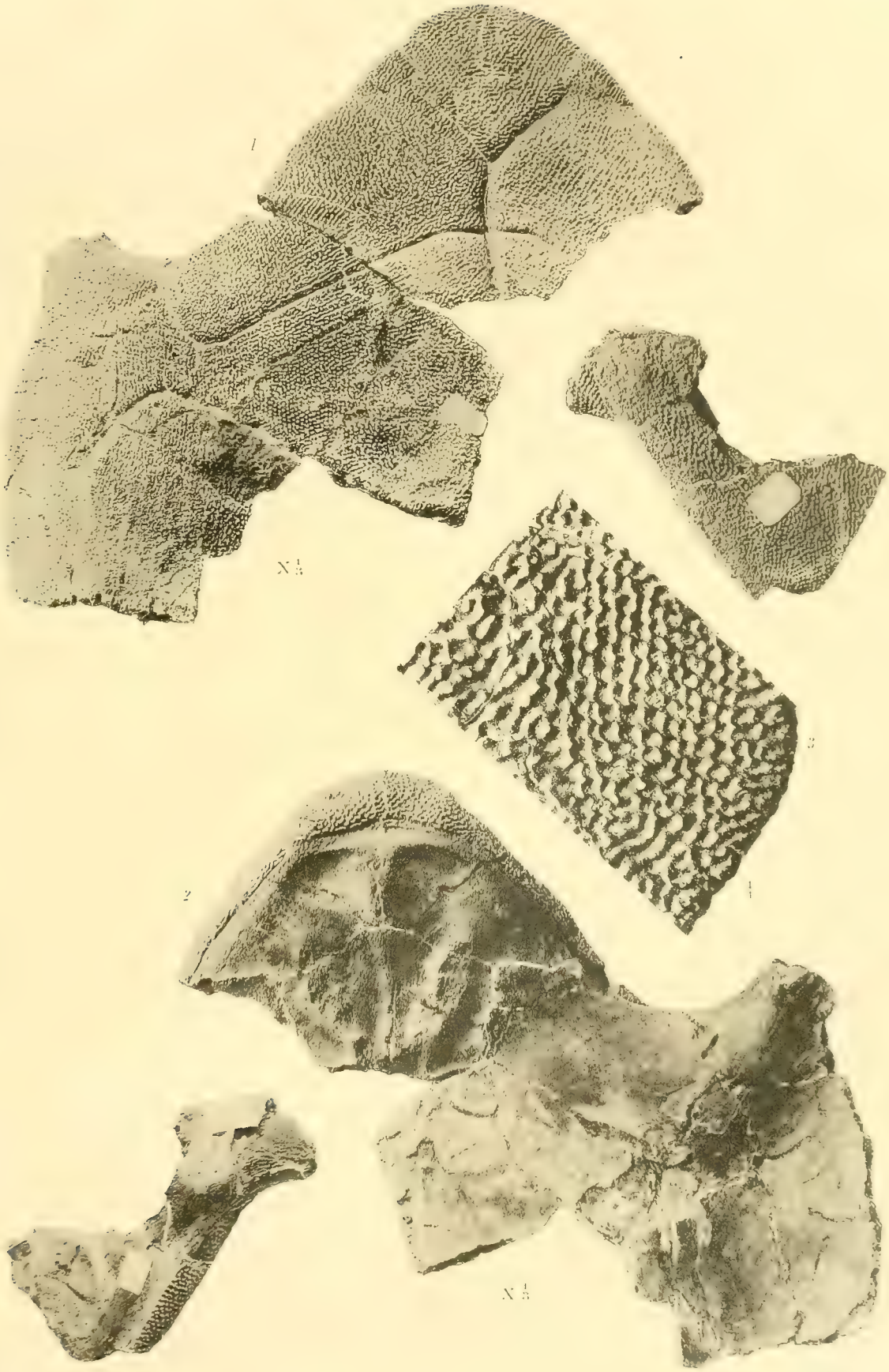
PLATE II.

Adocus variolosus, Cope. (sp.)

Fig. 1. Plastron, lower or outer surface of specimens represented in figures 4 and 5, page 39 ; one-third natural size. Page 39.

Fig. 2. The same, upper or inner surface.

Fig. 3. The lower surface at the anterior end of the same plastron, natural size ; to show the character of the sculpture.



HELIOTYPE CO., BOSTON.

PLATE III.

PLATE III.

Fig. 1. *Trachodon* (*Pteropelyx*) marginatus, Lambe, inner side of left ramus of lower jaw, showing the teeth ; one-half the natural size. Page 73.

e, coronoid process ; *a*, symphyseal surface ; *b*, inner wall of dental chamber ; *c*, mandibular groove ; *d*, foramen.

Fig. 2. *Trachodon* (*Pteropelyx*) selwyni, Lambe, inner surface of teeth of lower jaw, to show succession natural size. Page 69.

Fig. 3. Grinding surface of teeth of same specimen ; natural size.

Fig. 4. *Scapherpeton tectum*, Cope, dorsal vertebra, from the left side ; twice the natural size. Page 31.

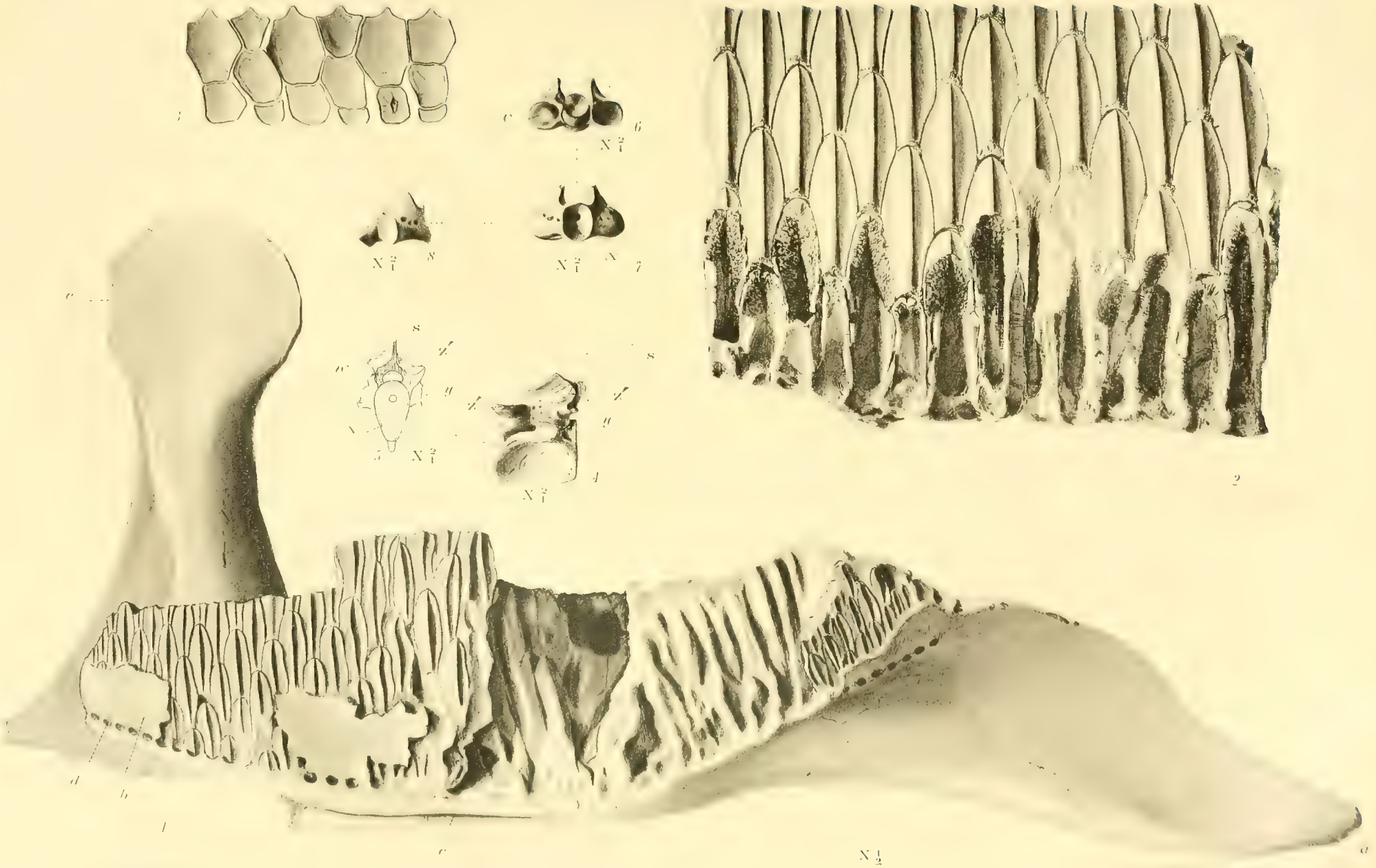
Fig. 5. View from the front, same specimen.

Fig. 6. *Scapherpeton tectum*, atlas, front view ; twice the natural size.

Fig. 7. The same, viewed from behind.

Fig. 8. The same, side view from the left.

y, diapophysis ; *z*, prezygapophysis ; *ẑ*, postzygapophysis ; *s*, neural spine ; *x*, anterior articural cup ; *w*, neural canal ; *v*, facet for occipital condyle of skull.



F. M. TAMIL, DELT.
HELIOTYPE CO., BOSTON.

PLATE IV.

PLATE IV.

Fig. 1. *Trachodon* (*Pteropelyx*) *marginatus*, Lambe, outer side of the same mandibular ramus figured on plate III; one-half the natural size. Page 73.

Fig. 2. *Trachodon* (*Pteropelyx*) *altidens*, Lambe, outer side view of left maxilla, one-half natural size. The speciman was drawn upside down so as to have a better light on the teeth. Page 76.

Fig. 3. Inner view of the same specimen, with part of the inner wall removed to show successional teeth; one-half natural size.

Fig. 4. Two teeth from the same specimen, showing the characteristic border sculpture, with the crown of the worn tooth restored, in dotted outline, to show the proportion of length to breadth; twice the natural size.

Fig. 5. *Trachodon* (*Pteropelyx*) *marginatus*, Lambe, outer view of apical part of crown of tooth from the maxilla represented on plate V, for comparison with fig. 4; twice the natural size. Page 74.

Fig. 6. *Trachodon* (*Pteropelyx*) *marginatus*, crown of one of the teeth of the ramus shown in fig. 1 of this plate and fig. 1 of the preceding plate; twice the natural size. Page 73.

Fig. 7. *Pteropelyx grallipes*, Cope, crown of tooth of lower jaw, to show border sculpture; twice the natural size. Introduced for comparison. Page 77.

f, grinding surface of teeth; *a*, facet for jugal.

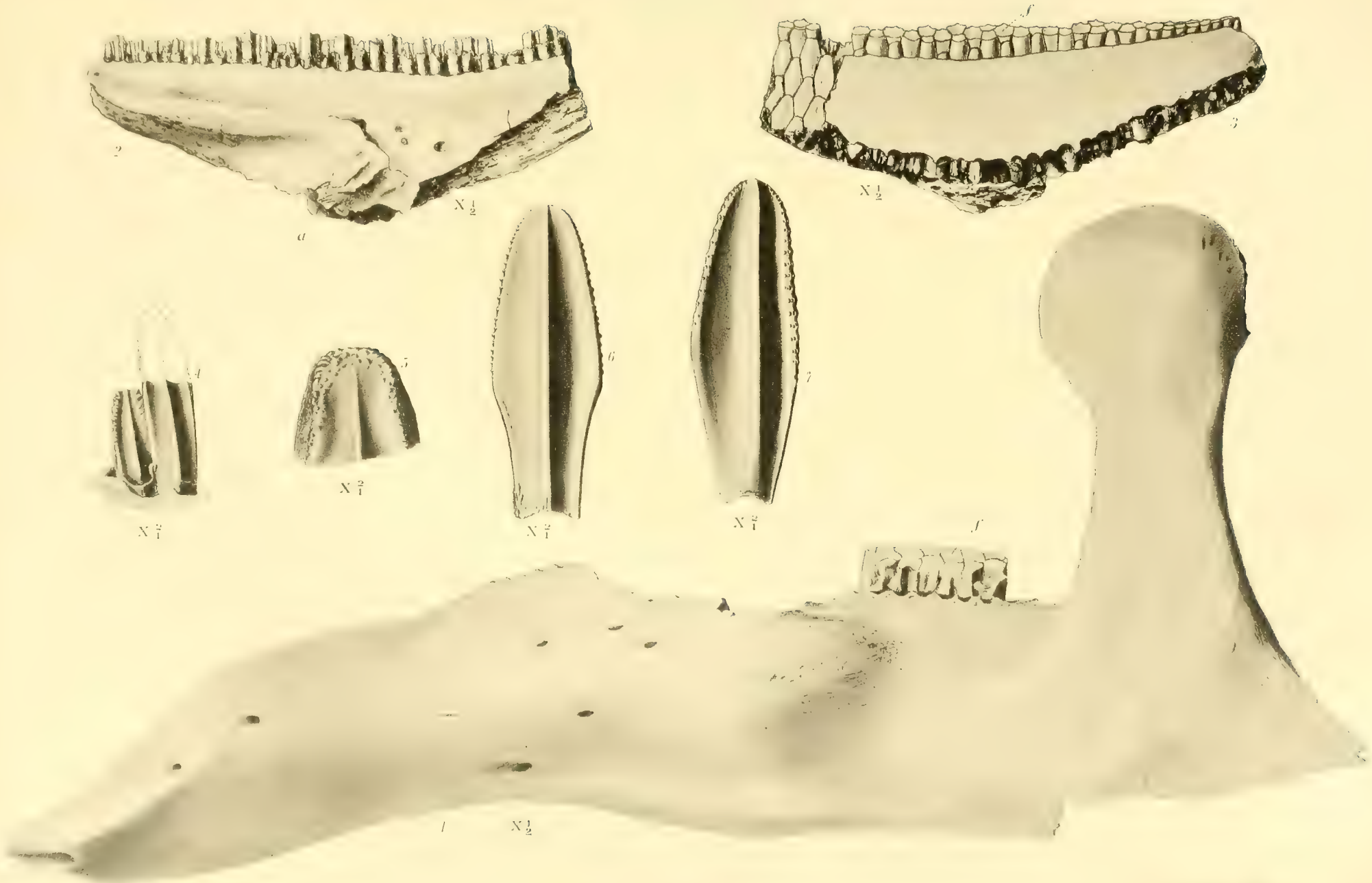


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PLATE V.

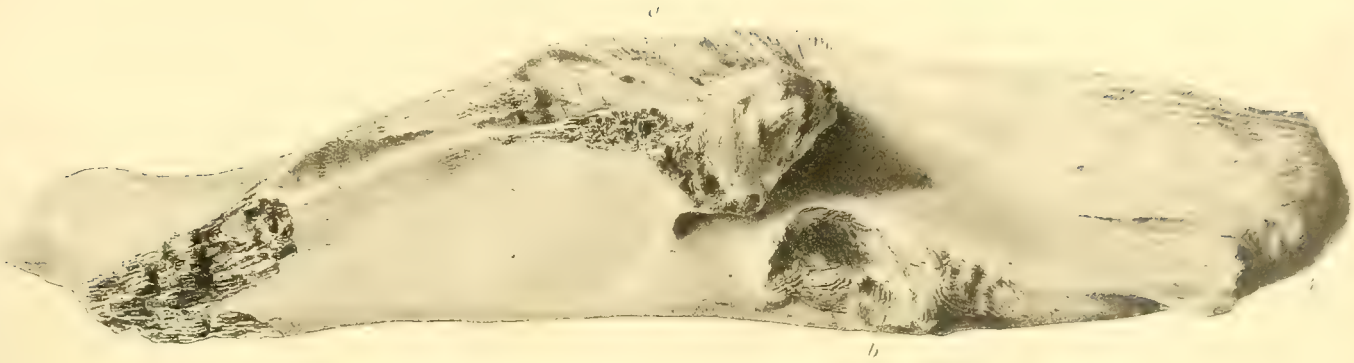
PLATE V.

Fig. 1. *Trachodon* (*Pteropelyx*) *marginatus*, Lambe, right maxillary bone, external view ; reduced one-half. Page 74.

Fig. 2. The same, internal view.

Fig. 3. The same, superior view.

a, facet for jugal ; *b*, facet for palatine.



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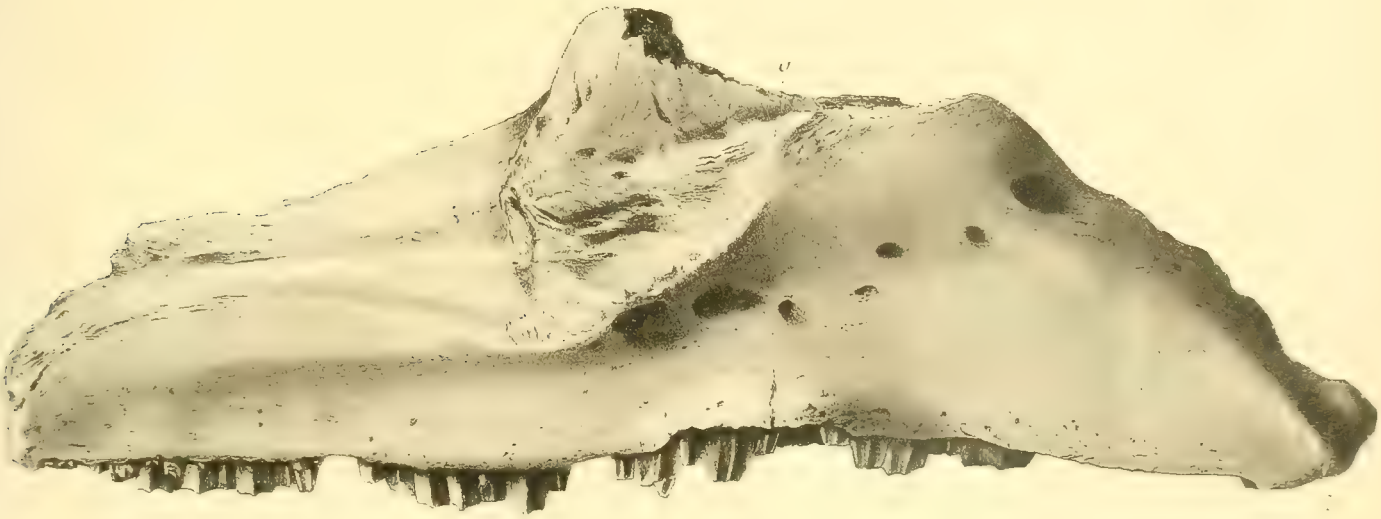

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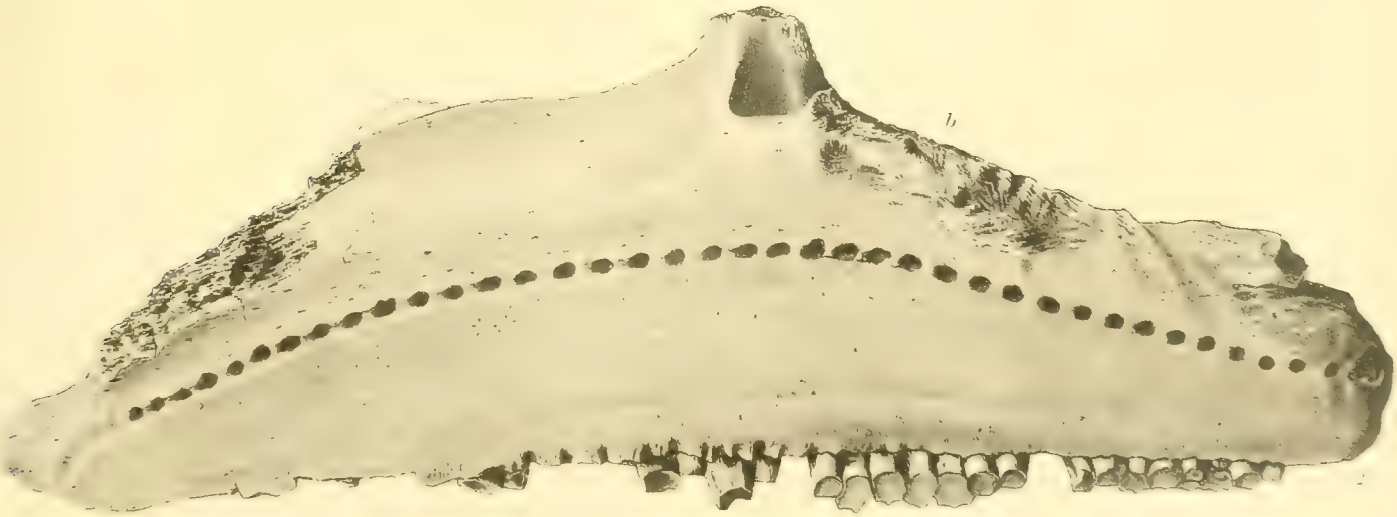

N ½

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PLATE VI.

PLATE VI.

Fig. 1. *Trachodon (Pteropelyx) marginatus*, Lambe, left humerus, viewed obliquely from inner front; one-third natural size. Page 71.

Fig. 2. The same, from outer rear.

Fig. 3. *Trachodon (Pteropelyx) marginatus*, impression of epidermis, from the sandstone in which the above specimen was embedded; natural size.

r, radial crest; *h*, head; *i*, inner tuberosity; *o*, outer tuberosity; *c*, outer condyle.

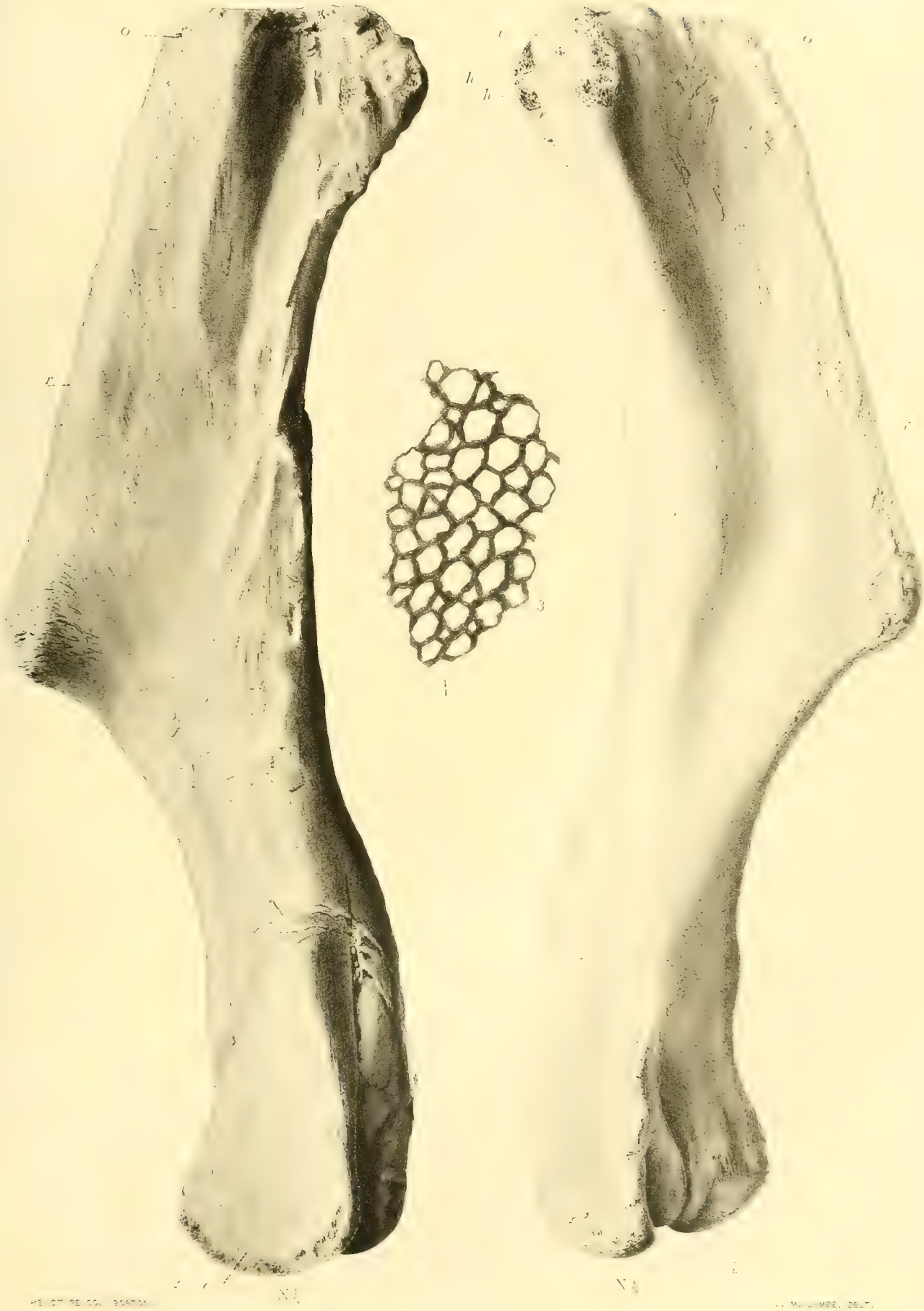
o
h
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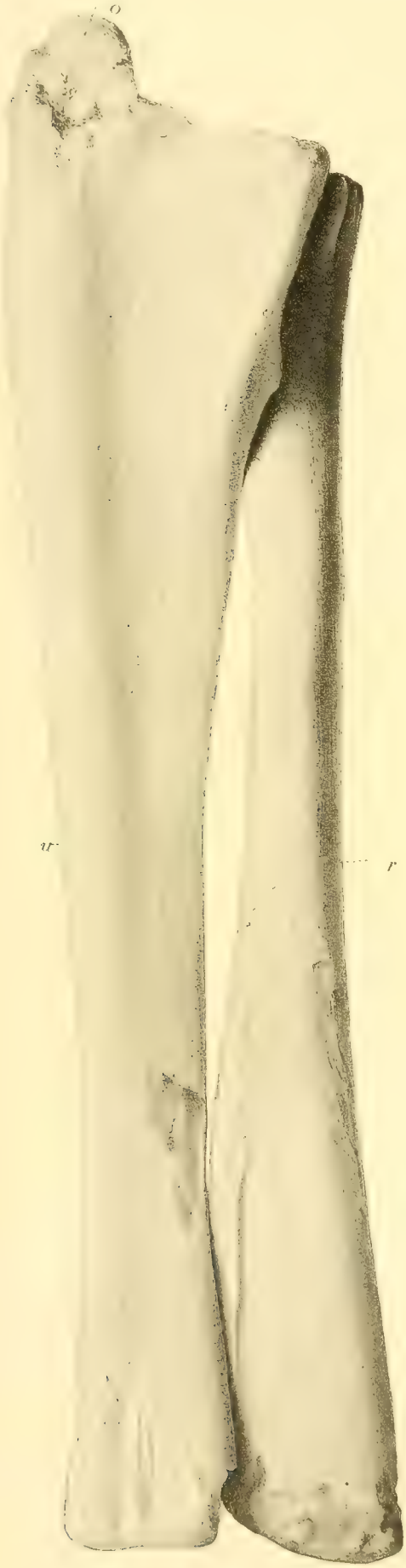
PLATE VII.

PLATE VII.

Fig. 1. *Trachodon (Pteropelyx) marginatus*, Lambe, left ulna and radius, anterior view; one-third natural size. From the same individual as that to which the humerus, figured on plate VI, belonged. Page 72.

Fig. 2. The same, posterior view.

u, ulna; *r*, radius; *o*, olecranon process.



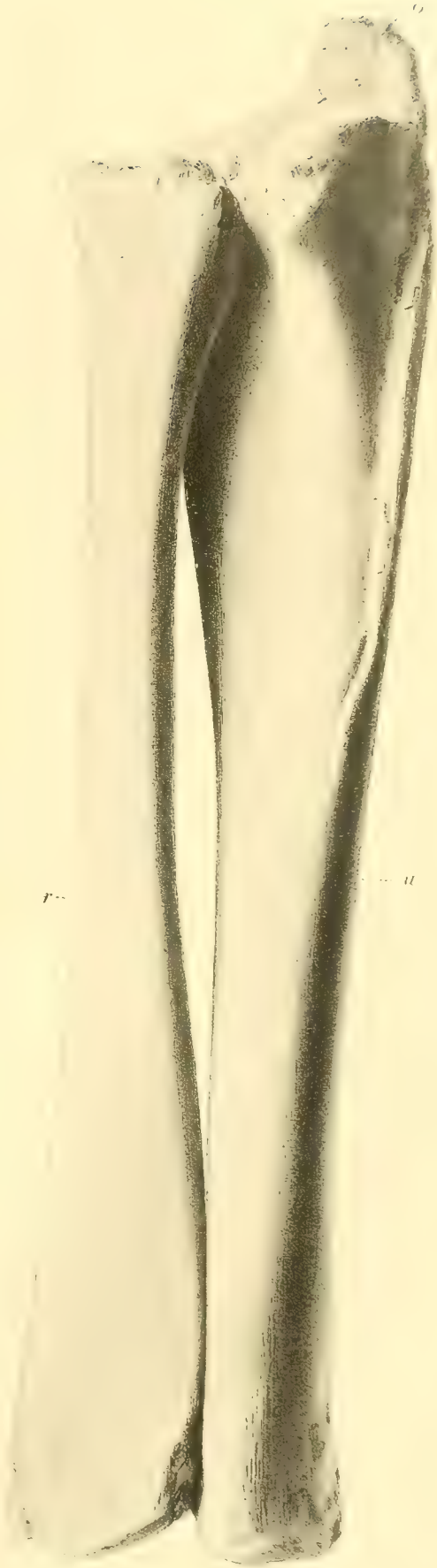


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PLATE VIII.

PLATE VIII.

Fig. 1. *Trachodon (Pteropelyx) marginatus*, Lambe, right femur, anterior view; one-fifth the natural size. (Provisionally associated with *T. marginatus*). Page 72.

Fig. 2. The same, internal view.

Fig. 3. The same, posterior view.

h, head; *t*, great trochanter; *m*, third trochanter; *c*, inner condyle.

1 2

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PLATE IX.

PLATE IX.

Fig. 1. *Trachodon (Pteropelyx) marginatus*, Lambe, right tibia, external view ; five twenty-thirds the natural size. (Provisionally associated with *T. marginatus*). Page 73.

Fig. 2. Another tibia of the same species, posterior view ; similarly reduced. (Provisionally associated with *T. marginatus*)

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PLATE X.

PLATE X.

Fig. 1. *Trachodon (Pteropelyx) marginatus*, Lambe, left pubis, external view; one-third the natural size. (Provisionally associated with *T. marginatus*). Page 74.

Fig. 2. *Trachodon (Pteropelyx) marginatus*, left ischium, external view; one-fifth the natural size. (Provisionally associated with *T. marginatus*). Page 75.

i, iliac facet; *b*, acetabular border; *g*, ischiac facet; *h*, postpubic process; *p*, pubic facet; *pp*, postpubic facet; *f*, flange.

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PLATE XI.

PLATE XI.

Stereocephalus tutus, Lambe, head armature, superior view ; natural size. The anterior end of specimen points downward. Page 55.

a, anterior end.

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PLATE XII.

PLATE XII.

Fig. 1. *Stereocephalus tutus*, *Lambe*, view of left side of specimen figured on plate XI., one-half the natural size. Page 55.

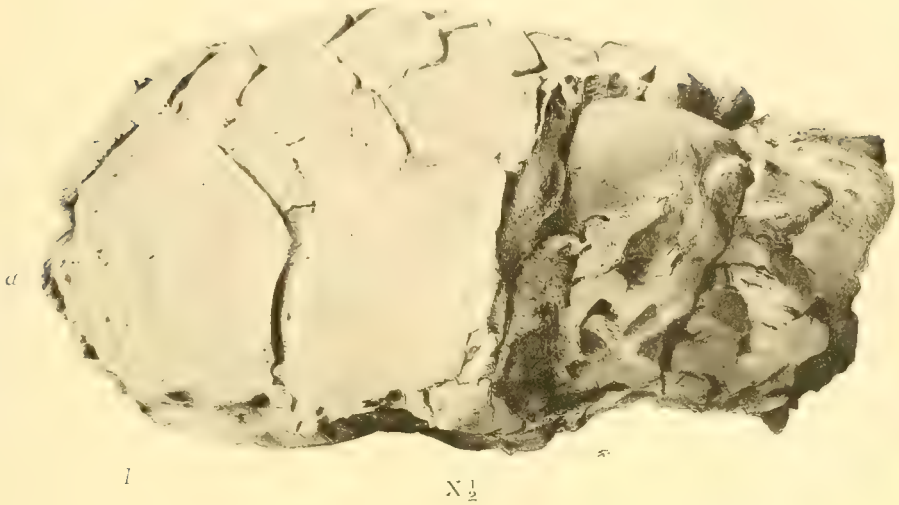
Fig. 2. Palatal view of the same; one-half the natural size.

Fig. 3. *Stereocephalus tutus*, coössified postcranial scutes, superior view; two-sevenths the natural size. Page 56.

Fig. 4. The same, anterior view.

Fig. 5. Transverse section of rib (provisionally associated with *S. tutus*); one-half the natural size. Page 55.

p, palatine; *s*, suture; *pt*, pterygoid; *v*, interpterygoid vacuity; *pb*, presphenoid and basisphenoid element; *a*, anterior; *b*, posterior.



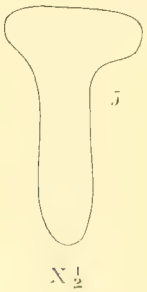


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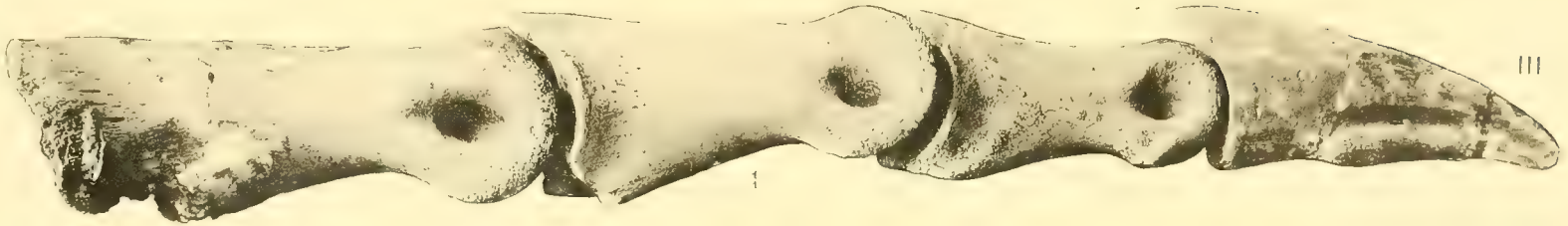
PLATE XIII.

PLATE XIII.

Ornithomimus altus, Lambe, phalanges of right pes, external view; natural size. Page 50.

II



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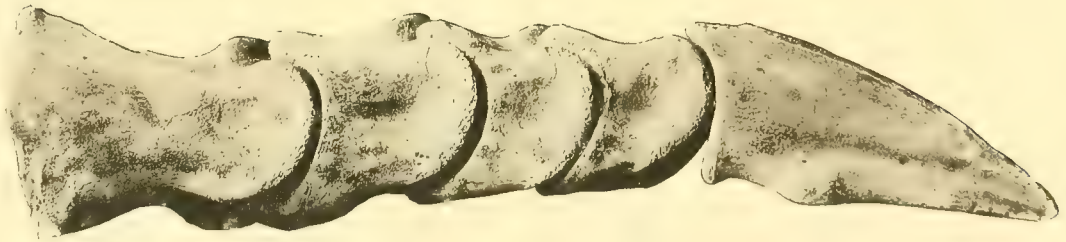

IV

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PLATE XIV.

PLATE XIV.

Ornithomimus altus, Lambe.

Fig. 1. Posterior dorsal vertebra, viewed from the left; natural size. Page 50

Fig. 2. Caudal vertebra, superior view; natural size. Page 52.

Fig. 3. The same, inferior view.

Fig. 4. The same, left lateral view.

Fig. 5. The same, posterior view.

Fig. 6. Distal end of metatarsal III. of left pes, viewed from the front; natural size. Page 50.

Fig. 7. The same, posterior view.

Fig. 8. Terminal phalanx of pes, side view; natural size. Page 50.

Fig. 9. The same, posterior view.

Fig. 10. Terminal phalanx of manus, side view; natural size. Page 52.

Fig. 11. The same, posterior view.

Fig. 12. Anterior tooth, provisionally associated with *O. altus*, side view, natural size. Page 53.

Fig. 13. Posterior view of the same, showing the minute denticulations on one of the two posterior carinæ.

s, neural spine; *z*, prezygapophysis; *ź*, postzygapophysis; *n*, neural arch; *d*, diapophysis; *f*, facet for chevron bone; *c*, neural canal; *e*, posterior articular face of centrum.

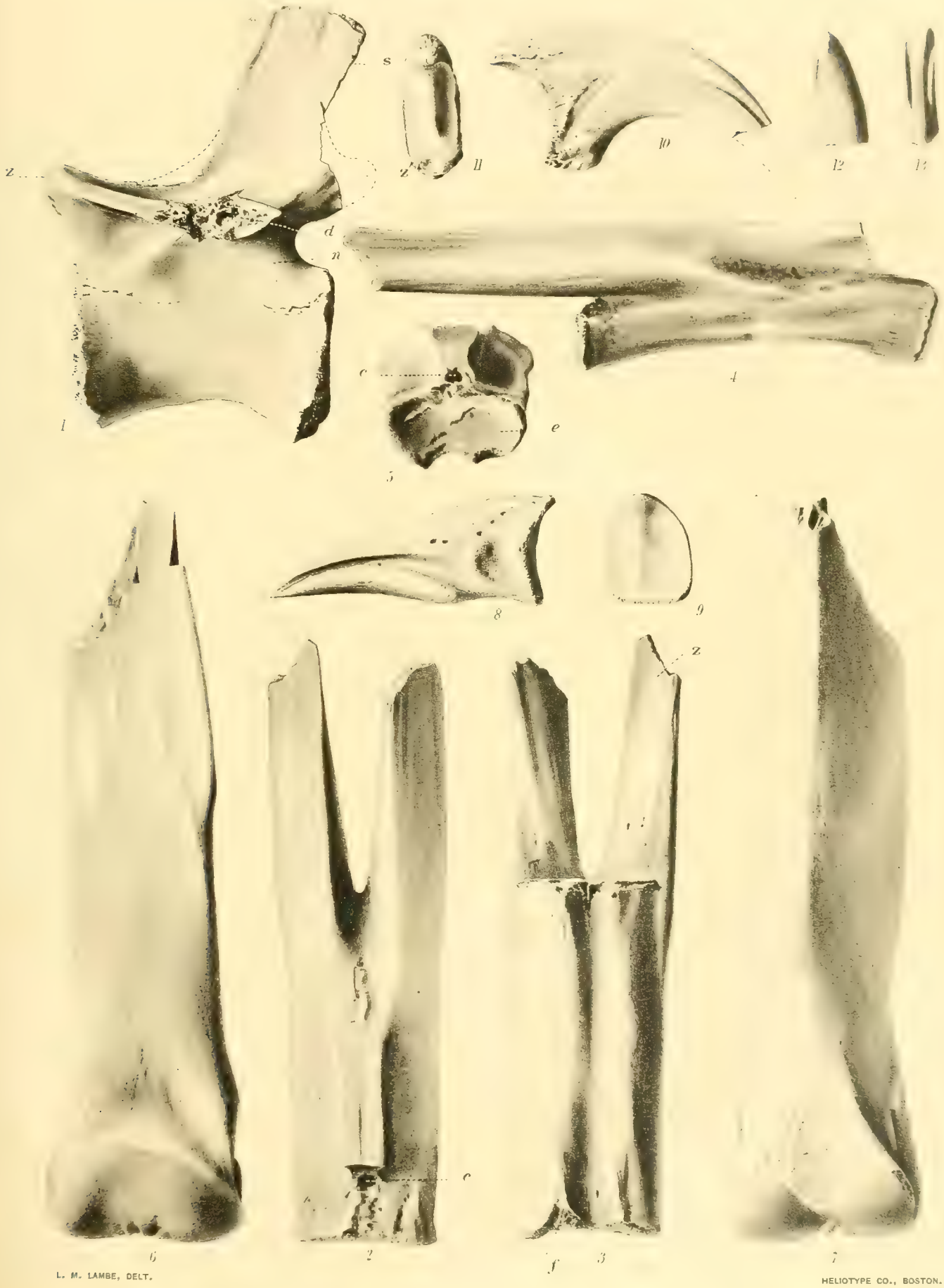

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PLATE XV.

PLATE XV.

Fig. 1. *Ornithomimus altus*, Lambe, caudal vertebra, superior view ; natural size. Page 52.

Fig. 2. View of right side of same.

Fig. 3. *Ornithomimus altus*, caudal vertebra, superior view ; natural size. Page 52.

Fig. 4. The same, inferior view.

Fig. 5. The same, right side.

Fig 6. *? Ornithomimus altus*, left side of lumbar vertebra of small individual ; natural size.

Fig. 7. The same, superior view.

Fig. 8. The same, anterior view.

Fig. 9. Terminal phalanx of megalosauroid dinosaur, lateral view ; natural size.

Fig. 10. The same, proximal view.

z, prezygapophysis ; *z'*, postzygapophysis ; *s*, neural spine ; e, transverse process.

Fig, 11. Tooth of *Deinodon explanatus*, Cope, side view ; four times the natural size. Page 49.

Fig. 12. Transverse section of the same.

Fig. 13. *Ptilodus primævus*, Lambe, right man libular ramus, external view ; enlarged four times. Page 79.

Fig. 14. The same, internal view.

pIV, fourth premolar ; *mI*, first molar ; *i*, socket for incisor ; *n*, socket for second molar.

Fig. 15. *Boreodon matutinus*, Lambe, premolar, side view ; four times natural size. Page 79.

c, cingulum.

Fig. 16. Right maxillary bone, (provisionally associated with *Scapherpeton tectum*), external view ; four times the natural size.

Fig. 17. Inferior view of the same, similarly enlarged. Page 32.

Fig. 18. Premaxillary bone of *Diphyodus longirostris*, Lambe, inferior view ; enlarged four times. Page 30.

Fig. 19. Transverse section of same, similarly enlarged.

t, tooth-base ; *nt*, interspace.

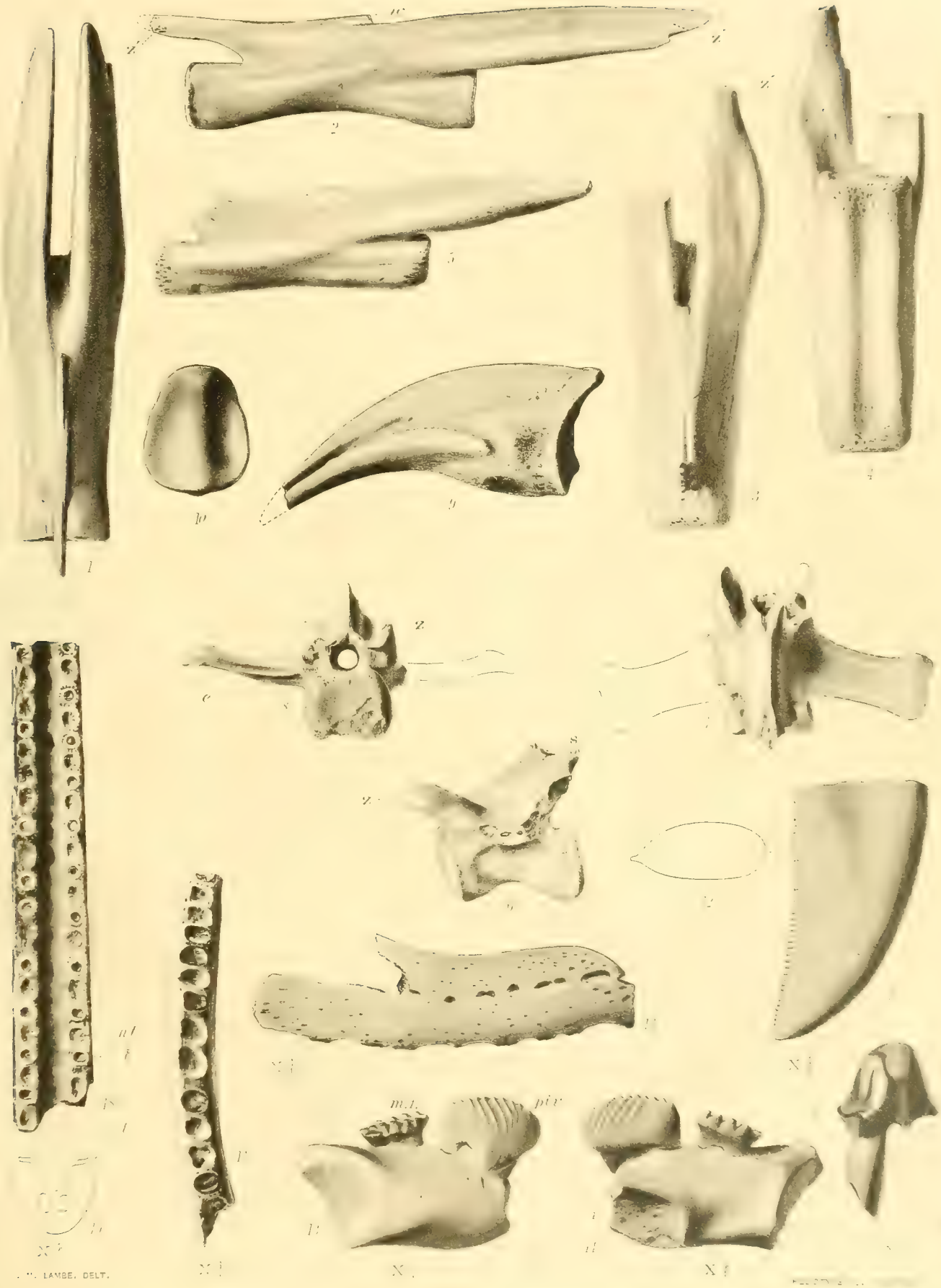

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PLATE XVI.

PLATE XVI.

Fig. 1. Sacrum, provisionally associated with *Monoclonius dawsoni*, Lambe, superior view ; two-sevenths the natural size. Page 61.

Fig. 2. The same, viewed from the right.

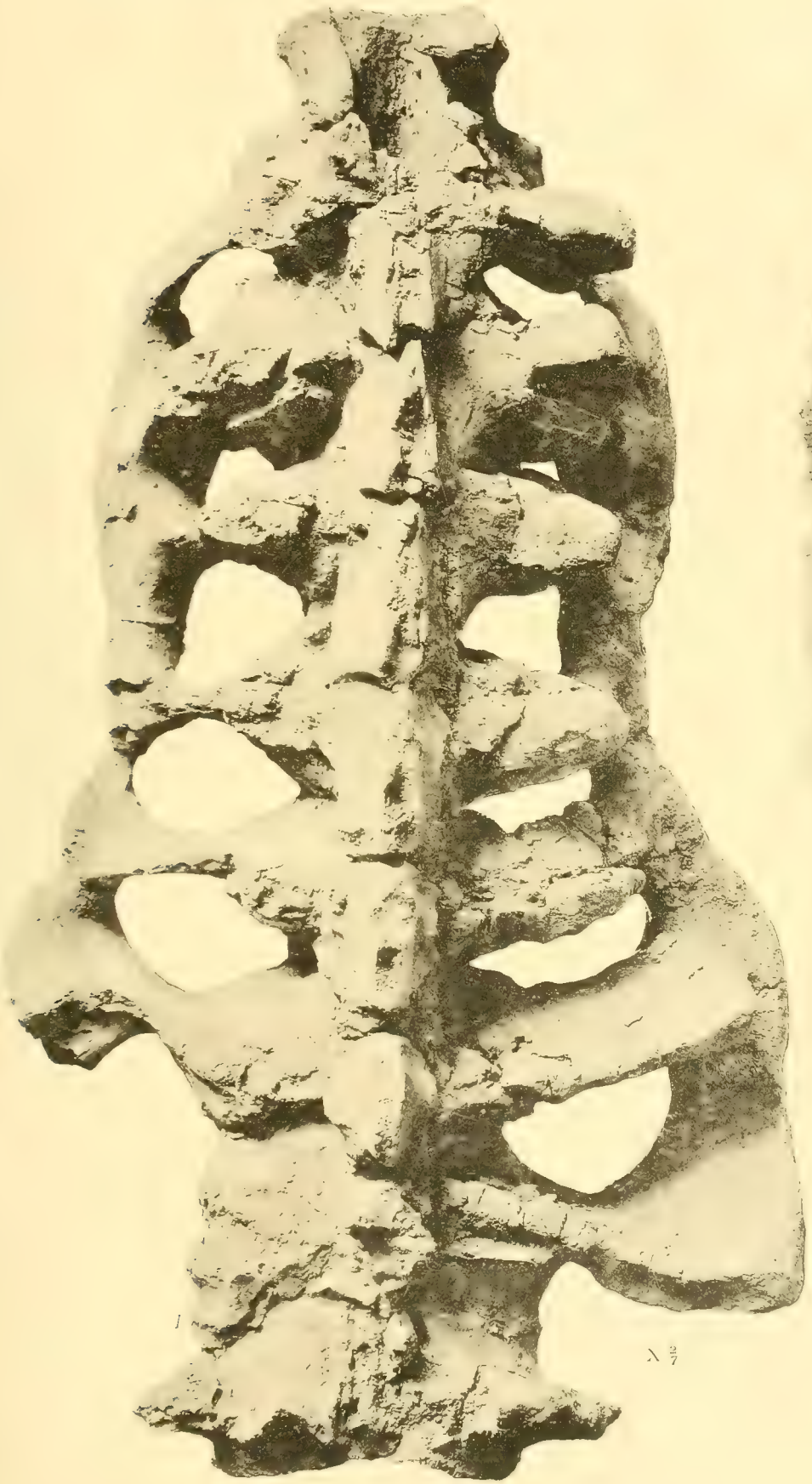

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PLATE XVII.

PLATE XVII.

Fig. 1. ? *Monoclonius dawsoni*, Lambe, side view of ? nasal horn core ; one-half the natural size.

Fig. 2. Sectional outlines of the same at "a" and "b".

Fig. 3. *Monoclonius canadensis*, Lambe, right orbital horn core, obliquely from behind ; one-halfe natural size. Page 63. *o*, orbit.

Fig. 4. The same, sectional outline at "a".

Fig. 5. *Palæoscincus asper*, Lambe, side view of tooth ; four times natural size. Page 54.

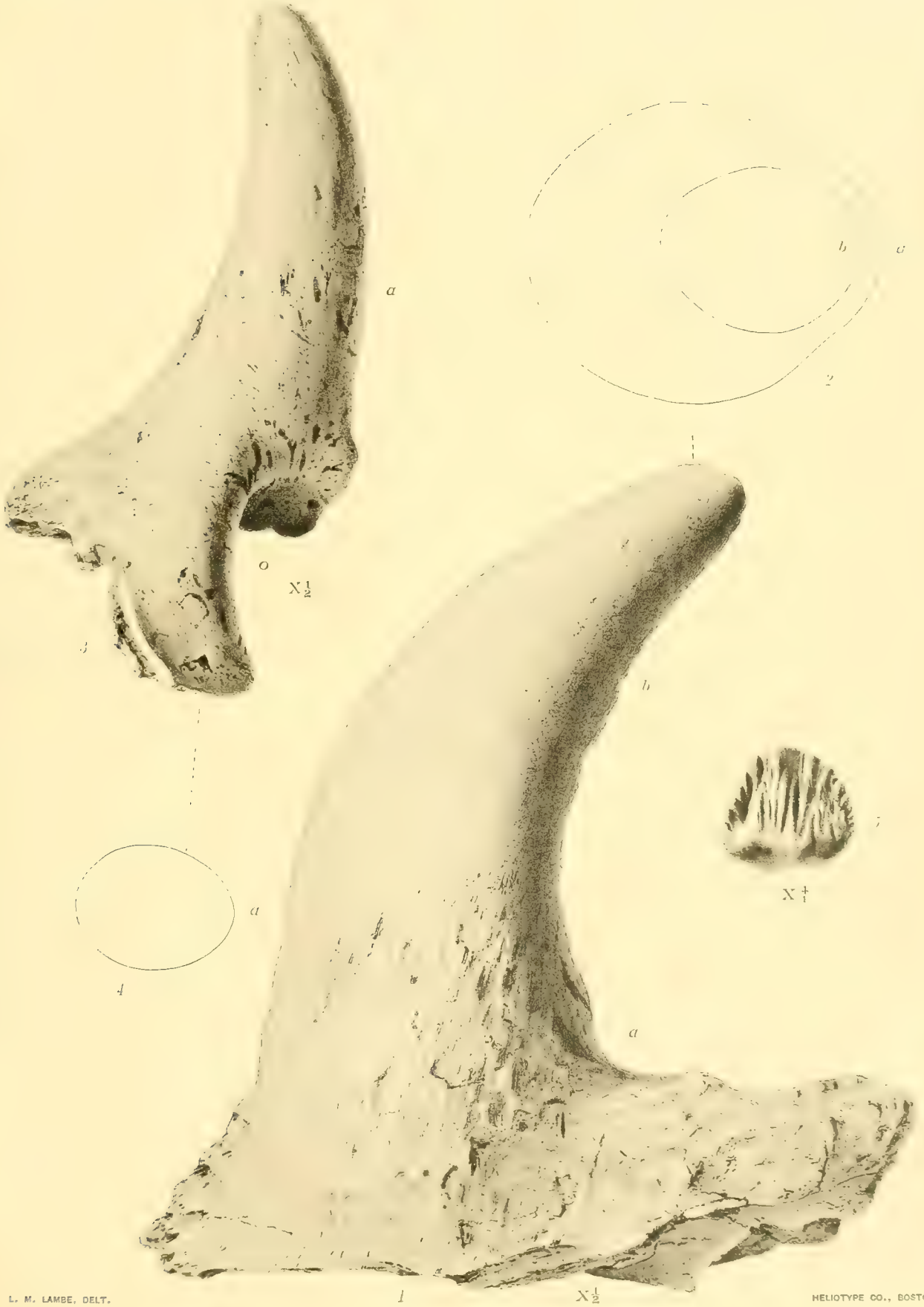

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PLATE XVIII.

PLATE XVIII.

Fig. 1. *Monoclonius canadensis*, Lambe, right mandibular ramus, external view; one-half the natural size. Page 65.

Fig. 2. The same, internal view.

Fig. 3. *Monoclonius canadensis*, maxillary tooth, external view; natural size. (Provisionally associated with *M. canadensis.*) Page 66.

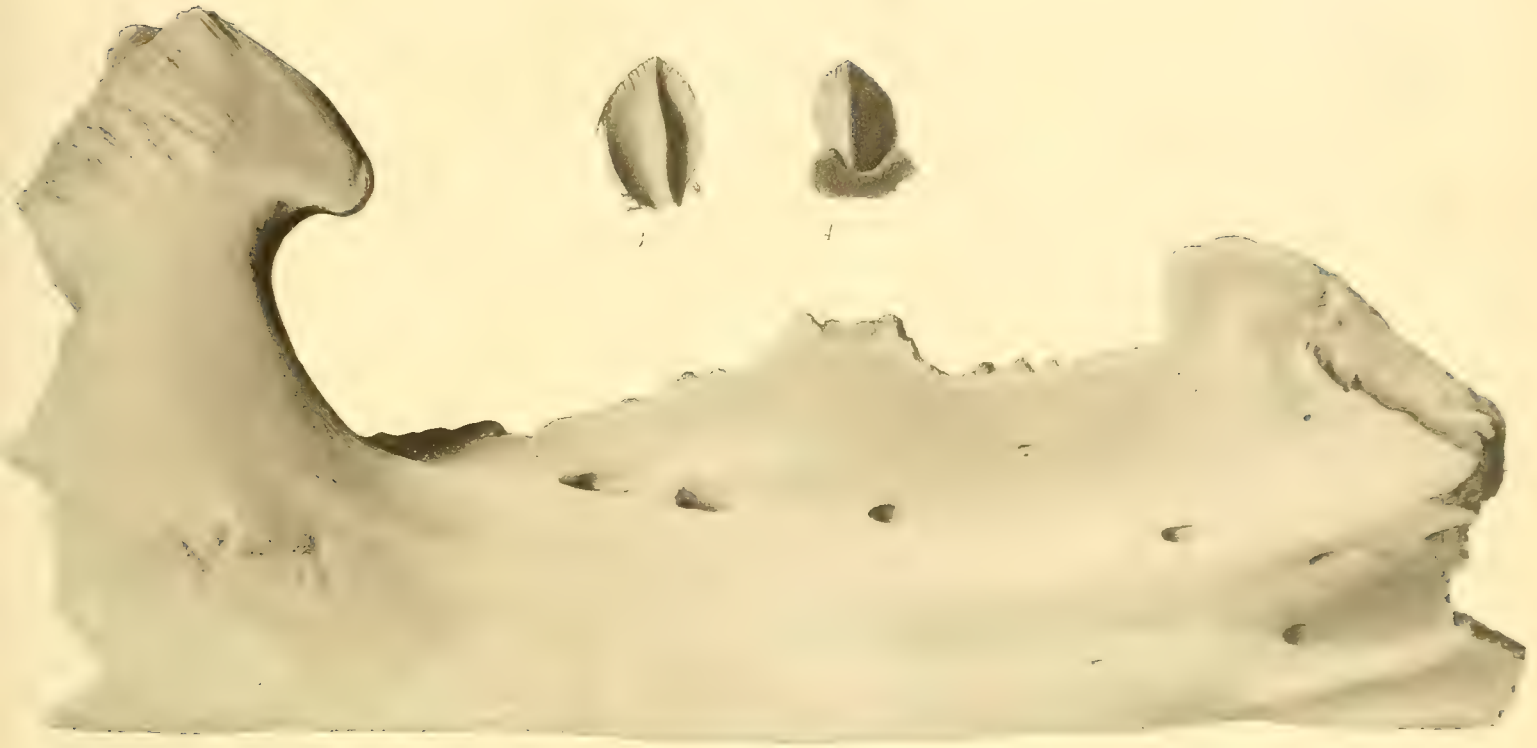
Fig. 4. Internal view of the same.

Fig. 5. Tooth from lower jaw, (provisionally associated with *M. canadensis*), internal view; natural size.

Fig. 6. The same, lateral view showing the two roots.

Fig. 7. The same, external view.

e, coronoid process; *a*, alveolar groove; *b*, symphyseal surface; *c*, mandibular groove; *f*, facet for predentary bone.



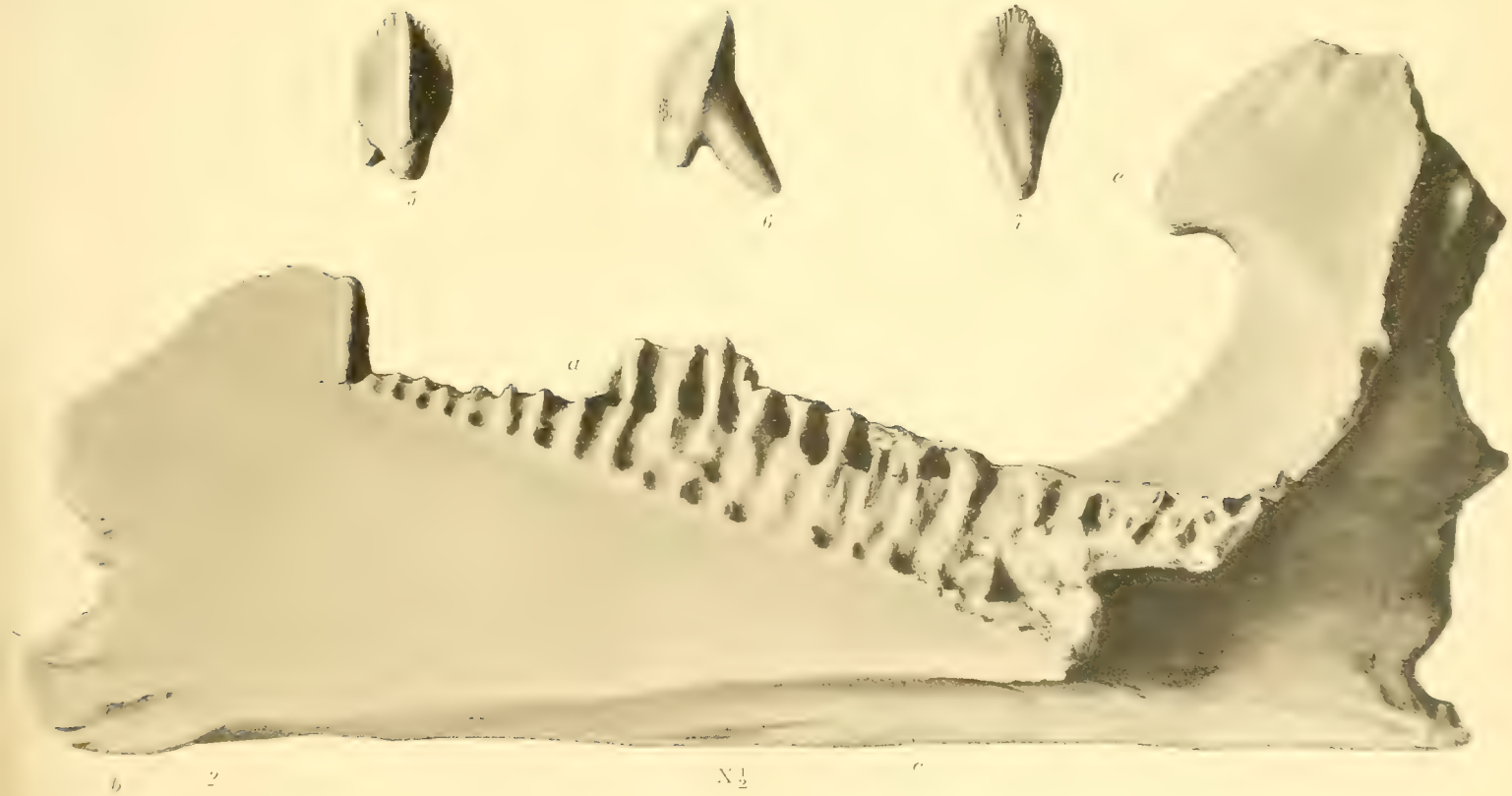


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PLATE XIX.

PLATE XIX.

Fig. 1. *Myledaphus bipartitus*, Cope, pavement tooth, face of crown; enlarged four times. Page 28.

Fig. 2. Side view of same tooth.

g, crown; *f*, face of crown; *r*, root.

Fig. 3. *Lepidotus occidentalis*, Leidy, outer surface of scale; natural size. Page 29.

Fig, 4. *Monoclonius dawsoni*, Lambe, left scapula and coracoid, internal view. (Provisionally associated with *M. dawsoni*); one-fourth natural size. Page 60

Fig. 5. *Monoclonius dawsoni*, predentary bone, lateral view. (Provisionally associated with *M. dawsoni*); natural size. Page 63.

Fig. 6. The same, viewed from above.

s, scapula; *c*, coracoid; *a*, suture between scapula and coracoid; *g*, glenoid cavity; *b*, upper border; *d*, anterior end; *e*, groove for dentary.

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PLATE XX.

PLATE XX.

Fig. 1. *Monoclonius belli*, Lambe, parietal element of posterior crest, superior view; one-third the natural size. Page 66.

Fig. 2. The same, inferior view.

Fig. 3. *Monoclonius dawsoni*, Lambe, rostral bone, side view; one-half the natural size. (Provisionally associated with *M. dawsoni*). Page 63.

Fig. 4. Outline of section of same at "c."

Fig. 5. Horn core with an asymmetrical base. Not specifically determined.

Fig. 6. Sectional outlines of same at "a" and "b."

g, groove for premaxilla.

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PLATE XXI.

PLATE XXI.

Fig. 1. *Stegoceras validus*, Lambe, prenasal bone ; side view. Natural size. Page 68.

Fig. 2. The same, inferior aspect.

Fig. 3. Superior view of another specimen ; natural size.

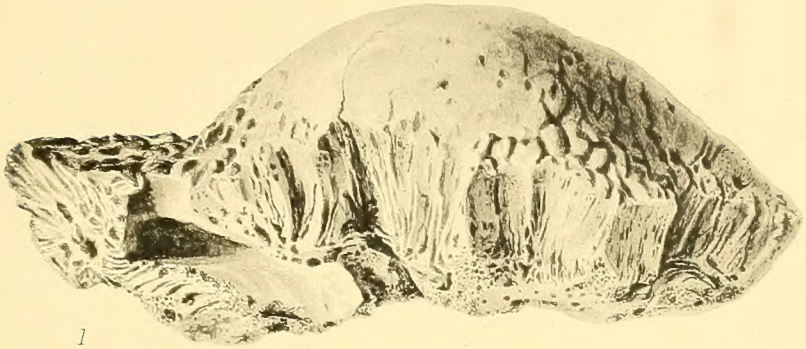
Fig. 4. The same ; side view.

Fig. 5. The same ; inferior view.

Fig. 6. *Stereocephalus tutus*, Lambe, symmetrical plate, superior aspect ; one-half the natural size. (Provisionally associated with *S. tutus*).

Figs. 7 and 8. Similar keeled plates ; one-half the natural size.

Fig. 9. Shield of *Acipenser albertensis*, Lambe, viewed from above. Natural size. Page 29.



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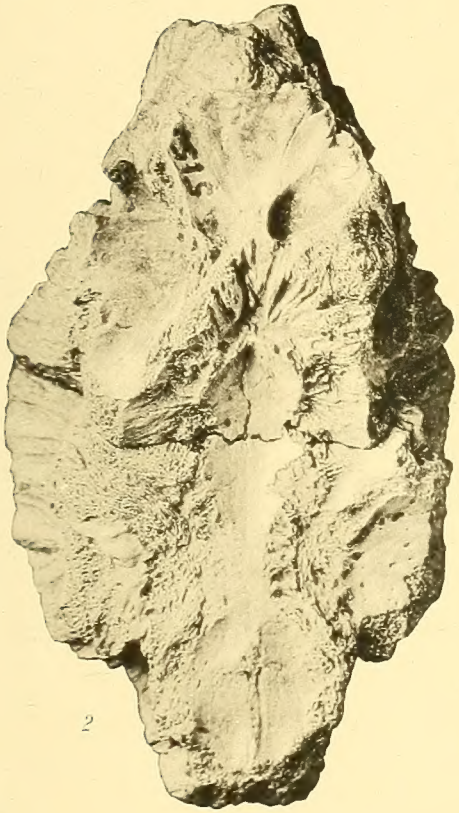

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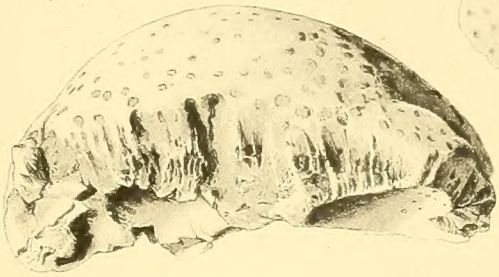

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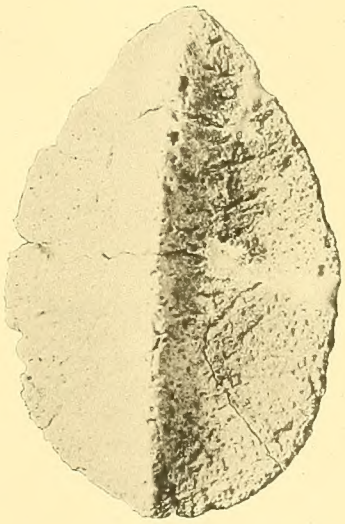

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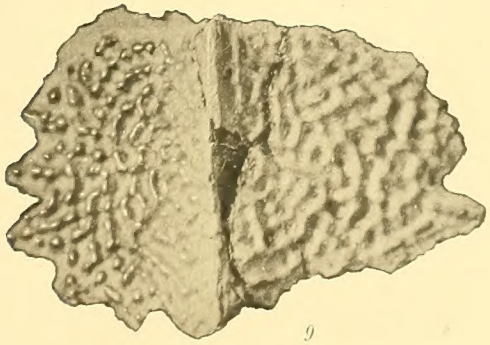
X½ 8



9

7 X½

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