III. SOME NEW AND LITTLE KNOWN FOSSIL VERTEBRATES.

By J. B. Hatcher.

(Plates I–IV.)

The present paper is based upon material brought together by the paleontological expedition of 1900, for which Mr. Andrew Carnegie generously supplied the necessary funds. The material has been freed from the matrix and prepared for study, either directly by, or under the immediate supervision of, Mr. A. S. Coggeshall, the chief preparator of the Museum in the Section of Vertebrate Paleontology. In the performance of this work Mr. Coggeshall has shown unusual skill and patience. The illustrations are from drawings by Mr. W. J. Carpenter and photographs by Mr. A. S. Coggeshall. In each instance they accurately illustrate important details of form and structure in the specimens described.

Class **PISCES.**

Platacodon nanus[1] Marsh.

In a former paper I have called attention to the undoubted ichthyic nature of the diminutive teeth collected by the writer several years ago and described by the late Professor Marsh as mammalian under the above name.[2] Subsequent to Professor Marsh's description of the types of this genus and species the present writer discovered in the same immediate locality, from which he secured the type specimens, two small dental plates, each bearing ankylosed teeth of the same size and pattern as the detached teeth described by Professor Marsh. The nature of these dental plates and the teeth they supported fixed at the same time their ichthyic nature and their identity with Platacodon. Both of these points Professor Marsh fully realized and frequently expressed in conversation with the writer. Other pressing duties doubtless prevented his making the necessary correction prior to his untimely death. During the past season I had occasion to visit the same

[1] See Am. Journ. Sci., Vol. XXXVIII, Aug., 1899, p. 178.

[2] See Science, N. S., Vol. XII, Nov. 9, 1900, p. 719.

locality that afforded Marsh's types, and was fortunate in finding a third fragment (No. 104)[3] of a dental plate with two teeth in position and exhibiting the scars of several other detached teeth as shown in Plate I, Figs. 5 and 6. These teeth have chisel-shaped crowns and are very much compressed, apparently with the longer axis directed transversely. They are quite distinct from other dental plates found somewhat abundantly in the same deposits, which are also of ichthyic nature, but in which the crown of each tooth consists of a single rather low tubercle, circular in cross-section.

Class **REPTILIA.**

Subclass **Dinosauria.**

Order PREDENTATA.

Suborder ORNITHOPODA.

The Dermal Covering of Claosaurus[4] Marsh.

The first information regarding the nature of the dermal covering of dinosaurs was given by the writer in a brief communication to Science on *The Carnegie Museum Paleontological Expedition of 1900*.[5] A little later Mr. F. A. Lucas[6] called attention to the appearance of dermal impressions similar to those mentioned by the writer, and shown by material collected by Mr. Robert Butler for the U. S. National Museum, and pertaining to the same genus, *Claosaurus* (Thespesius), as does that on which the present observations are based. Through the kindness of Mr. Lucas I am able to give here (Fig. 1) an illustration, natural size, of these impressions as represented on a slab of sandstone enclosing the bones of one of the fore limbs of the specimen in the U. S. National Museum.

[3] The numbers enclosed in brackets in this paper refer to the Card Catalogue of Fossil Vertebrates in the collection of the Carnegie Museum.

[4] *Claosaurus* Marsh has been considered to be a synonym of *Thespesius* Leidy, (See Lucas, in Science, N. S., Vol. XII, Nov. 23, 1900. p. 809); while the latter genus has been considered a synonym of *Hadrosaurus* Leidy, by another authority. (See *Dinosaurierreste aus Siebenbürgen*, by Franz Baron Nopsca, jun., Band LXVIII der Denkschriften der Mathematisch-Naturwissenschaftlichen Classe der Kaiserlichen Akademie der Wissenschaften, pp. 555–591.) In consideration of the incomplete nature of Leidy's type of *Thespesius* I retain *Claosaurus*.

[5] See Science, N. S., Vol. XII, Nov. 9, 1900, pp. 719–720.

[6] See Science, N. S., Vol. XII, p. 809.

Among other remains of Laramie dinosaurs, collected in Wyoming during the past season, there is a large slab of sandstone, containing a considerable portion of the pelvis and sacrum and some twenty of the anterior caudals, as well as numerous ossified dorsal tendons, so abun-

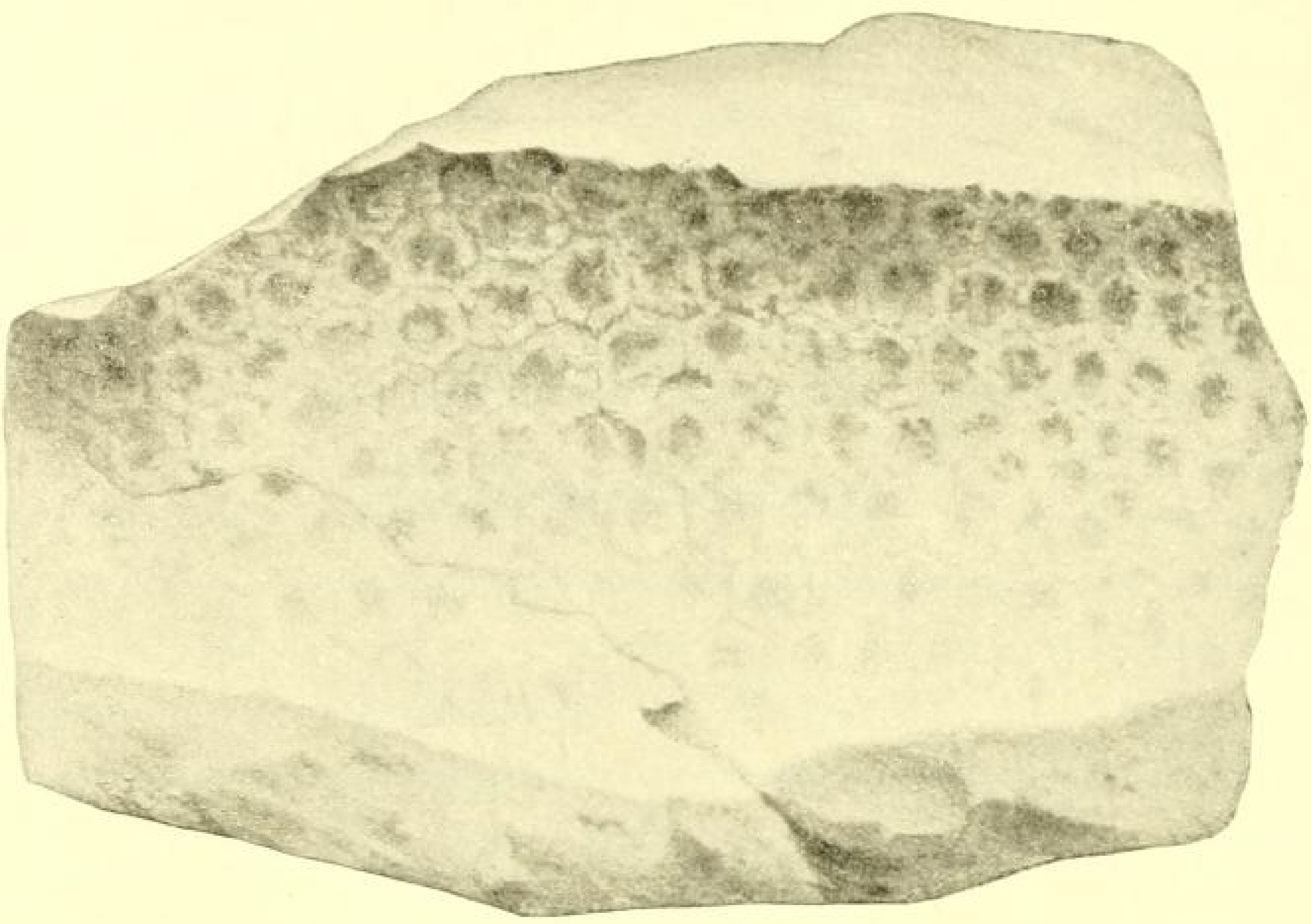


FIG. 1.

Dermal impression from forelimb of Claosaurus (Thespesius) annectens Marsh. (Nat. size). (Specimen in U. S. National Museum.)

dant in *Claosaurus*. This specimen (No. 106) derives its chief interest, however, from the fact that there are preserved in the region extending from the fifteenth to the twentieth caudals an impression of the dermis, which shows these animals to have been covered in life with small bony, or chitinous scutes. In my original notice of these dermal scutes I referred to them as small hexagonal plates. A closer examination, however, shows that they are not all of the same size or geometrical form. Our material shows that there was in some instances a central heptagonal plate some 9 mm. in greatest diameter,[7] surrounded by seven somewhat smaller hexagonal plates. These, or similar rosettes, appear to have been arranged in bands extending from the top of the dorsal region of the tail down the sides in parallel lines, each band separated from the succeeding and preceding series by narrow transverse ridges, the interstices between the hexagonal plates and transverse

[7] In my notice in Science I spoke of thes plates as somewhat more than half an inch in diameter, while by actual measurement they are somewhat less than half an inch.

ridges being filled in with smaller plates. The exact outline of some of these smaller plates cannot be determined from our specimen. A figure of a portion of the dermal impression is shown in Plate I, Fig. 8. The material was found by the writer in the Ceratops beds of the Upper Laramie, about three miles north of the mouth of Doegie Creek, in Converse County, Wyoming.

Class **MAMMALIA.**

Order UNGULATA.

Suborder ARTIODACTYLA.

Leptochœrus quadricuspis, sp. nov.

The type of the present species (No. 100) consists of the right maxillary with P.^{3} and ^{4} and M.^{1}, ^{2}, and ^{3} in position and in an excellent state of preservation. It was found by the writer in a small exposure in the lower Oreodon beds about half a mile west of south of the Brewster and Emmons Ranch, on Warbonnet Creek, in Sioux Co., Nebraska. Associated with the type specimen, but evidently belonging to different individuals, were found other remains of *Leptochœrus*, consisting of an isolated tooth, M.^{2} (No. 101), a fragment of a left ramus (No. 102) with M. , $_{2}$, $_{3}$, a portion of a right ramus (No. 103) with M.$_{1}$, $_{2}$, $_{3}$ and P.$_{4}$ and the alveoles of P.$_{3}$. The last mentioned specimen (No. 103) may be taken as the collateral type of the species.

The present species chiefly differs from *L. spectabilis* Leidy,[8] the type of the genus, in size, it being a third smaller than the latter, as will be seen by a comparison of the measurements given here with those of Leidy published in his original description. A comparison of the specimens shows other structural differences as well. From *L. gracilis* of Marsh[9] it is distinguished by a greater complexity of tooth structure, and, more especially, by the structure of P.^{3} and M.^{1} and ^{2}.

In the type of the new species P.^{3} is the more prominent tooth of the series. Its crown is triangular in outline and bears four distinct cusps, which have suggested the specific name. Of these cusps three are external and one internal. Of the three external cusps, the one in the middle is much the larger, and it is situated directly opposite the internal cone, which latter is of about the same prominence as the an-

[8] See Proc. Acad. Nat. Sci. Phila., p. 88, 1856.

[9] See Am. Jour. Sci., Vol. XLVIII, Sept., 1894, pp. 271–273.

terior and posterior external cones, and stands at the apex of a triangle, the base of which would be formed by a line connecting the two latter cones. A rather strong basal cingulum extends all along the external and anterointernal borders of this tooth, completely surrounding externally the anteroexternal cone. There is no basal cingulum on the posterointernal border of this tooth.

Premolar^{4} is a much smaller and simpler tooth than P.^{3} or M.^{1} which immediately precede and succeed it. The crown of P.^{4} supports but two cones, the one external, the other internal. The former is a little the more prominent of the two. This tooth is quadrangular in outline and bears a basal cingulum on its exterior, anterior, and posterior borders, but not on its interior border.

Commencing with M.^{1} the molars gradually decrease in size and become less complicated from M.^{1} to M.^{3}. The crown of M.^{1} is subquadrangular in outline, and bears three principal cones, two of which are external and of about equal size, while the third is internal and somewhat larger. This internal cone shows a decided tendency to divide into anterior and posterior internal cones, the latter of which is much the smaller of the two and partakes more of the nature of a conule. Two ridges diverge from near the apex of the internal cone of this tooth and form small anterior and posterior intermediate cones, or conules, so that there are on M.^{1} six cusps, two of which are external, two internal, and two intermediate. The two intermediate and the posterointernal are much less prominent than the other three. A basal cingulum surrounds the external and anterior and posterior borders of this tooth.

The succeeding tooth, M.^{2}, has a quadrangular crown, supporting two external cones and a somewhat larger internal cone, which shows less tendency to division than does the same cone on M.^{1}, but does, nevertheless, show a small conule developing near the apex on its posterior side. The two intermediate cones mentioned as present on the crown of M.^{1} are also present on M.^{2}. There is a basal cingulum on the external and posterior and anterior borders of this tooth.

Molar^{3} is much the smaller tooth of the molar series, and is of somewhat simpler structure than the others. There are two small external cones and a rather prominent, perfectly simple, inner cusp, with but faint indications of the intermediate conules noticed in M.^{2} and M.^{3}. A basal cingulum surrounds the tooth except on the internal side, where it is quite smooth.

The presence of a fourth cone on $P.^{3}$, together with the tendency to division exhibited by the internal cones of $M.^{1}$ and $M.^{2}$, at once distinguish this species from *L. gracilis* of Marsh. By some these characters might be considered of generic importance, but I have preferred to treat them as of only specific value.

A diastema exists in front of $P.^{3}$, but the bone is broken away a little in front of that tooth. The infraorbital foramen is situated above and slightly in advance of the anterior border of $P.^{3}$. A crown view of the type specimen is shown in Plate I, Fig. 3, while Fig. 4 is a reproduction of Marsh's type of *L. gracilis*.

I have selected No. 103 as a collateral type of the present species, since it agrees in size and was found in the same locality with the type. It consists of a portion of a right ramus with $P._{4}$ and $M._{1}$, $_{2}$, $_{3}$ in position and the alveoles of $P._{3}$. It is about one third smaller than Leidy's type of *L. spectabilis*, while agreeing very well in size and tooth structure with the lower jaw of Marsh's type of *L. gracilis*, though differing from the latter in wanting the deep groove on the inner side of the jaw, which, according to Marsh, extends from the dental foramen nearly to the symphysis. In the present specimen $P._{4}$ is the larger tooth of the series. It is subtrenchant and supports a principal median cone with a small tubercle on the narrow anterior border, while expanding posteriorly to form a broad heel with low external and internal cones. Molars $_{1}$ and $_{2}$ are quadrangular in outline, with crowns supporting four cusps, two anterior and two posterior, each pair connected by transverse ridges, while in addition an oblique ridge joins the anterointernal cone with the posteroexternal cone of each true molar, a character not shown in Marsh's figures of *L. gracilis*. In addition to the four cones and three crests already described, there is in $M._{3}$ a third posterior lobe bearing a fifth cone situated behind and intermediate to the posterior paired cones.

The ramus is proportionately quite strong and increases in depth anteroposteriorly. There is a small foramen on its external surface between $P._{3}$ and $_{4}$, about midway between the superior and inferior borders.

MEASUREMENTS OF THE TYPE (NO. 100).

	M.
Length of superior true molar series	.013
" " $M.^{1}$	.005
" " $M.^{2}$	.004
" " $M.^{3}$	.0035
" " $P.^{4}$	.0042
" " $P.^{3}$	.007

	M.
Breadth of P.^{3}	.005
Greatest breadth of P.^{4}	.0065
" " " M.^{1}	.0063
" " " M.^{2}	.0055
" " " M.^{3}	.0045

MEASUREMENTS OF COLLATERAL TYPE (NO. 103).

Depth of ramus below anterior border of P.$_{\overline{4}}$	.0105
" " " " middle of M.$_{\overline{2}}$	.013
Length of inferior true molar series	.0158
" " M.$_{\overline{1}}$	.005
" " M.$_{\overline{2}}$	.005
" " M.$_{\overline{3}}$	.0058
" " P.$_{\overline{4}}$	.007
Greatest breadth of P.$_{\overline{4}}$	.005
" " " M.$_{\overline{1}}$	.005
" " " M.$_{\overline{2}}$	.005
" " " M.$_{\overline{3}}$	.004

TAXONOMY OF LEPTOCHŒRUS.

There has been a disposition on the part of some authorities to place Leptochœrus among the Primates. This has doubtless been due to the very close resemblance shown by the true molars of this genus to the same teeth in certain genera of the earlier Primates, more especially of the Prosimiæ or Lemurs. Most if not all of the discoveries of Primates, that have from time to time been reported from the White River, Oligocene formations of the West, have been based on the true molars of Leptochœrus. Such references of these teeth when found unassociated with the premolars were very natural and quite in accordance with our knowledge of comparative odontography. The premolars are however quite unlike those of any known primate living or extinct, while at the same time showing very close resemblances, as do also the molars, to certain artiodactyls with the bunodont type of tooth. These facts, together with certain skeletal characters referred to by Marsh in his description of *L. gracilis*, would appear to establish the artiodactyl affinities of the genus.

Suborder PERISSODACTYLA.

Orohippus ? sp.

In our collections of vertebrates from the White River Beds there is an isolated superior molar (No. 99), which agrees in general structure with the superior molars of *Orohippus*, and I have provisionally referred it to that genus. I refrain from proposing for it a new generic name, while at the same time recognizing the improbability that the genus Orohippus should have existed continuously from the Bridger Eocene to the White River Oligocene. The unexpected occurrence of a tooth of this pattern, indicative of an animal closely allied to the middle Eocene equines, would appear to justify a notice of its discovery, with a brief description of its principal characters, though its exact generic and specific distinction will be deferred until the discovery of additional material shall make known its true affinities.

This tooth, which appears to be the left first superior molar, was found by Mr. W. H. Utterback at the base of the Titanotherium Beds, in an exposure about one mile south of Henry's Dam, on Squaw Creek, in Sioux County, Nebraska. A crown view of it is shown on Plate I, Fig. 7. It agrees almost exactly in size and structure with the first molar of *Orohippus* as figured by Wortman on page 108, Vol. VIII of the Bulletins of the American Museum of Natural History. The crown is in outline almost a perfect square, and supports four subequal cones, each occupying one of the four angles of the tooth. In addition to these four principal cones there are two small intermediate cones, or conules. A basal cingulum surrounds the tooth except on the inner side. This tooth has an anteroposterior diameter of .009 metres and a maximum transverse diameter of .0095 metres.

Trigonias osborni Lucas.[10]

Dentition, I.$\frac{3}{3}$, C.$\frac{1}{0}$, P.$\frac{4}{4}$, M.$\frac{3}{3}$ = 42. *None of the upper premolars are strictly molariform. Skull much elongated and very large in comparison with the size of the skeleton. Manus tetradactyl.*

This new genus of the early Oligocene Rhinocеridæ is represented in our collections by two skulls and one nearly complete skeleton, beside numerous other bones, all from the lower Titanotherium Beds of the White River Oligocene. Only a very small portion of this material has as yet been unpacked and freed from the matrix. It is the intention of the present communication to record only a few of the more important characters, reserving a description of the complete osteology for a future paper, after all of our material has been prepared for study.

[10] See Proc. Nat. Museum, Vol. XXIII, No. 1207, pp. 221–223.

THE CRANIUM.

In our collection there is one nearly complete skull, without the lower jaw (No. 96) of a very old individual, in which the structure of the molar and premolar teeth, except in M.^{3}, has been obliterated by wear. A second skull (No. 98), also wanting the lower jaw, but probably pertaining to a younger, though fully adult animal, shows the molars and premolars on either side in splendid condition, save P.^{1}, which has been lost. A third specimen, (No. 97), consists of a complete lower jaw with all the teeth in position on either side, with the exception of I.$_{3}$, which is represented only by an alveolus. No. 96 is the cranium of a very old individual, apparently a female. When found in the matrix it lay on one side, and had been subjected to great pressure, resulting in considerable distortion, the entire cranium being compressed laterally. It is proportionately long and narrow, exhibiting few rugosities. There is a distinct, rather sharp, and somewhat elevated sagittal crest, expanding posteriorly into the slightly elevated, narrow, emarginate occipital crest, which overhangs the occipital condyles. The paroccipital process is short and blunt, curves forward inferiorly, but does not come in contact with the longer, but rather slender, postglenoid process, so that the meatus auditorius externus is left open below. The zygomata are of considerable vertical diameter, but are exceptionally thin in transverse diameter. The squamosals enter into the construction of the zygomata to a greater extent than do the malars. The orbit is nearly circular in outline with a decided postorbital constriction due to the presence of pronounced postorbital processes both on the frontals and malars. The brain-case is small. There is a marked temporal constriction. The infraorbital foramen is placed directly above the middle of P.^{4}. The nasal incision is very deep; its posterior margin is on a line drawn vertically from the posterior border of P.^{2}. The premaxillaries are long and slender and have an extensive contact with the maxillaries. The maxillopremaxillary suture extends from in front of the canine to a point directly above the middle of P.^{1}. The premaxillaries do not come in contact with the nasals and do not coössify at their anterior extremities. The nasals are long, slender and acute. They terminate anteriorly almost directly above the anterior border of the premaxillaries. A side view of the skull, one fourth natural size, is shown in Plate II, Fig. 1.

THE MANDIBLE.

The present description of the mandible of *Trigonias osborni* is based on a complete lower jaw (No. 97) of a somewhat young animal, in which M.$_{\overline{3}}$ is seen in process of eruption. The jaw is proportionately long and remarkably slender. It does not appreciably increase in depth from the posterior border of the symphysis to the posterior border of M.$_{\overline{2}}$. The inferior border is gently convex. There is a mental foramen directly below the anterior root of P.$_{\overline{2}}$. The angle is not produced below the inferior border of the jaw. The angle is slightly deflected and there is a short, gently concave area between its anterior extremity and the preceding inferior border of the jaw. The condyle is placed almost at right angles to the ascending ramus, with the articular surface somewhat more elevated and broader externally than internally. The coronoid process is well developed and pointed posteriorly at the apex. The masseteric fossa is deep and situated rather high up on the ascending ramus; its inferior border is on a line approximating that of the crowns of the inferior teeth. The inferior dental foramen is placed somewhat nearer the inferior than the superior border and just behind the last molar. The symphysis is long, narrow, and obliquely horizontal. It terminates posteriorly immediately below the mental foramen, and there is a decided constriction anterior to P.$_{\overline{1}}$.

THE DENTITION.

The dental formula is I.$\frac{3}{3}$, C.$\frac{1}{0}$, P.$\frac{4}{4}$, M.$\frac{3}{3}$ = 42.

The superior dentition: I.$^{\underline{1}}$ is hypertrophied, and is a large, laterally flattened tooth, with a chisel-shaped, rectangular crown. It is much the more persistent of the superior incisor series. Incisors $^{\underline{2}}$ and $^{\underline{3}}$ are lost in both of our skulls, but the alveoli are preserved on either side in No. 96, and the same is true of the superior canine, which is separated from I.$^{\underline{3}}$ by a short diastema. Between the canine and P.$^{\underline{1}}$ there is a long diastema. P.$^{\underline{1}}$ is unfortunately represented in both our crania only by the roots. These indicate that this tooth was rather large and well fixed in the jaw for a superior first premolar. The succeeding teeth are all present in both our skulls, but too much worn in No. 96 to permit of a description of their structure, except in M.$^{\underline{3}}$, which is fairly well preserved. In No. 98 these teeth are well preserved and show the following characters: The premolar series increase in size anteroposteriorly. None of the superior premolars are molariform. *P.*^{2} *has not yet developed the two distinct transverse crests so characteristic of all previously known Aceratheres and Rhinoceroses.* All the premolars show a rather large postfossette and a small prefossette opening into a larger medifossette entirely enclosed internally. There is a small crista on each, separating the prefossette from the medifossette, while the ectoloph of each supports an anterior and posterior costa and a rudimentary parastyle. Internal cingula are present on P.^{2}, ^{3}, ^{4}. I wish here to call attention to the apparent difference in the structure of P.^{4} on opposite sides, due to different degrees of wear exhibited by these teeth in the same skull as shown in Plate II., Fig. 2. In M.^{1} the median sinus is well developed, completely separating the protocone and hypocone. The ectoloph supports a well developed parastyle, separated from the anterior costa by a well marked fold. The posterior costa is faint. This tooth is much worn, but remnants of the post- and medifossettes remain. M.^{2} is the larger tooth of the series ; the protocone is more prominent than the hypocone ; there is a postfossette and a medifossette invaded by an antecrochet. The ectoloph supports a well developed parastyle and anterior costa, with scarcely an indication of the posterior costa. In M.^{3} the metacone is absent, while the protocone, paracone and hypocone, are well developed. There is a deep medifossette unobstructed by either crochet, antecrochet, or crista. There is a parastyle and a strong anterior costa. All the superior molars bear anterior and posterior basal cingula.

The inferior dentition : The first pair of lower incisors are small spatulate teeth with the longer axis directed transversely. They are remarkably procumbent and are placed anterior to and between the second pair of incisors, which have become hypertrophied into large procumbent teeth, which in the rhinoceroses generally, have been usually mistaken for canines rather than incisors. Just below their crowns these teeth are oval in cross-section. Immediately behind I.$_{2}$ there is a shallow alveolus, which with Lucas, I have assigned to I.$_{3}$ rather than the canine. Whether it was occupied by the canine or I.$_{3}$ is of minor importance,—in either case it fixes the large procumbent tooth as a modified incisor, as was pointed out by Lucas in his original description of the genus. I.$_{3}$ is separated from P.$_{1}$ by a long diastema. P.$_{1}$ is a small, laterally compressed tooth, fixed in the jaw by two roots, and bearing on its crown anterior, median, and posterior cones arranged longitudinally, with but faint indications of the anterior, median, and posterior cross-crests. Premolars $_{\overline{2}}$, $_{\overline{3}}$, $_{\overline{4}}$, are all submolariform, regularly increasing in their approximation to the true molar pattern from P.$_{\overline{2}}$ to P.$_{\overline{4}}$. In each of these teeth the anterior and posterior cross-crests are not as fully developed as are the same elements in the lower true molar series. The inferior molars exhibit no distinctive characters.

MEASUREMENTS.

FULLY ADULT SKULL, (NO. 96).

Length in straight line from point of nasals to emargination of occipital crest	496 mm.
Height of occiput above lower border of occipital condyles	155 mm.
Depth of incision of anterior nares	140 mm.
Greatest length of premaxillaries	110 mm.

LOWER JAW OF YOUNG ANIMAL, M.$_{\overline{3}}$, NOT FULLY ERUPTED.

Greatest length of jaw on straight line	385 mm.
Length of symphysis	85 mm.
Depth of ramus below P.$_{\overline{2}}$	51 mm.
Depth of ramus below M.$_{\overline{2}}$	51 mm.
Height of coronoid process above inferior angle.	187 mm.

SUPERIOR DENTITION OF FULLY ADULT SKULL.

Distance from anterior border of I.$^{\underline{1}}$ to posterior border of canine	63 mm.
Length of diastema between canine and P.$^{\underline{1}}$	37 mm.
Length of premolar series	86 mm.
Length of molar series	103 mm.

INFERIOR DENTITION OF YOUNG LOWER JAW.

Transverse diameter of crown of I.$_{\overline{1}}$	8.5 mm.
Fore and aft diameter of crown of I.$_{\overline{1}}$	6 mm.
Length of crown of I.$_{\overline{2}}$	36 mm.
Transverse diameter of I.$_{\overline{2}}$ at base	16.5 mm.
Supero-inferior diameter at base	13.5 mm.
Length of diastema between I.$_{\overline{3}}$ and P.$_{\overline{1}}$	29 mm.
Length of premolar series	95 mm.
Length of molar series	117 mm.

THE SCAPULA, FORE LIMB, AND MANUS.

The scapula is comparatively long, slender, and subtriangular in outline. The posterior border is concave, and extends from the glenoid cavity for about two thirds of the total length of the scapula, where, at an obtuse angle, it meets the convex superior border. The anterior border is convex. The postscapula is triangular in outline, while the general outline of the prescapula is subcrescentic. The coracoid is small. The spine extends from about two inches above the glenoid cavity to the superior border. It is triangular in outline with a rather strong spinous process directly opposite the angle formed by the junction of the posterior and superior borders. The glenoid cavity is rather deep and subcircular in outline.

The humerus, like all the other bones of the fore leg, is proportionately rather long and slender. The greater and lesser tuberosities are prominent, and the bicipital groove is correspondingly deep. The deltoid ridge is well developed and continuous throughout one half the entire length of the bone. The supinator ridge is low and short. The external condyle is prominent, while the internal is faint, or obsolete. The ulnar and radial articulations enter subequally into the construction of the trochlea, the former slightly predominating. The anconeal fossa is deep.

The radius is rather broad and flat, with its transverse diameter almost twice the fore and aft diameter. The distal end is much broader and deeper than the proximal. The anterior surface is strongly convex inferiorly, while the posterior surface is concave.

The shaft of the ulna is triangular in cross-section. The olecranon is of moderate height, broad, and with an anterosuperior notch. The coronoid process is large and sharp anteriorly, in harmony with the deep anconeal fossa of the humerus. Distally there is a moderate articular facet for the pyramidal, and relatively a rather large articular surface for the pisiform.

The manus of *Trigonias osborni* differs from all other American Aceratheres, so far as we know their structure, in being functionally tetradactyl. In the present genus and species the fifth digit is not only present, but it still retains all the elements (metacarpal, first, second, and third phalanges and sesamoids) common to digits II, III, and IV. These elements are however somewhat reduced in size.

The carpus is composed of those elements that are ordinarily found in that of the perissodactyl manus, viz., superiorly, the scaphoid, lunar, pyramidal, and pisiform; inferiorly, the trapezium, trapezoid, magnum and unciform. The scaphoid is much the larger bone of the proximal series. It articulates above with the radius by a concave surface of irregular pentagonal outline. Inferiorly the scaphoid articulates with the trapezium, trapezoid and magnum, covering the entire upper surface of the first two, and only about one half the superior anterior surface of the magnum, thus contrasting strongly with some of the later tridactyl Aceratheres, in which the scaphoid covers the entire superior anterior surface of the magnum. The facet for the trapezium is slightly concave, and has the general form of an elongated ellipse. The articular facet for the trapezoid is concave transversely and convex anteroposteriorly. Two rather sharp ridges separate it from the facet for the trapezium on the one side and that for the magnum on the other. The latter facet is triangular in outline, and gently concave transversely. The radial facet of the lunar is strongly convex anteroposteriorly, while inferiorly this bone articulates with the magnum by an elongated, deeply concave facet, broad posteriorly, but somewhat constricted anteriorly. With the unciform it has also an extensive contact, ovate in outline and concave anteroposteriorly. The pyramidal shows the usual superior facets for the ulna and pisiform, while inferiorly it articulates only with the external superior surface of the unciform, occupying somewhat less than one half the upper surface of that bone. The pisiform articulates about equally with the pyramidal and ulna. The neck is much constricted, while the tuberosity is greatly expanded, terminating superiorly in an elevated process. The trapezium is the most diminutive bone in the distal series of carpals. It articulates superiorly with the scaphoid and exteriorly with the trapezoid, terminating inferiorly in a small pointed process without articular surface. The trapezoid is a small bone with superior and inferior facets, concave anteroposteriorly and convex laterally. These articulate respectively with the scaphoid and metacarpal II. The magnum is comparatively large, and bears three articular facets on its superior surface, one situated anteriorly and external, articulating with the scaphoid; a second, narrow in front, but expanding posteriorly, situated about midway between the external and internal margins, and articulating with the lunar; the third is placed anteriorly and internal, and articulates with the unciform. Inferiorly the magnum articulates only with metacarpal III, while there is also a lateral articulation between the magnum and metacarpal II. The tuberosity is narrow and directed downward and inward. The unciform is much expanded inferiorly and articulates by a continuous facet with metacarpals V, IV, and the external one third of the proximal end of metacarpal III, and in addition it covers about one third of the upper anterior surface of the magnum. This extensive, continuous articular surface is exceptionally regular in outline, and its anterior edge describes an almost perfect semicircle. Superiorly the unciform articulates subequally with the lunar and pyramidal.

The metacarpus. Although tetradactyl in structure, the manus of Trigonias shows a decided tendency in the direction of tridactylism. Metacarpal III is the longer and much the stronger bone of the series, while metacarpals II and IV are subequal. The inevitable suppression to which the fifth digit is destined, is already distinctly indicated both by the inferiority of its metacarpal and by that of the succeeding phalanges. Nevertheless, there is still a very considerable modification necessary before the manus of Trigonias assumes the typically tridactyl structure of the later Rhinoceroses and Aceratheres. Metacarpal III is decidedly asymmetrical, and the axis of the foot is external to its median line, while the superior anterior surface of the magnum is not so completely occupied by the scaphoid as in the later tridactyl forms.

The phalanges. As in all the Rhinocerotidæ, the phalanges are short and rather flat, with rugose upper surfaces. The unguals, especially those of digits II, III, and IV, are broad and very short. There are present the metacarpophalangeal and navicular sesamoids characteristic of Perissodactyls in general.

The material, upon which the above description of the scapula, fore limb, and manus is based, consists of a complete right manus, limb, and scapula (No. 95) found in position along side of the skulls (Nos. 96 and 98) described above. It appears to pertain to the same individual as No. 96, and associated with it was the opposite fore-limb, pelvis, ribs, vertebræ, hind limbs, and most if not quite all of the skeleton, for the most part disarticulated. All this material, including the lower jaw described above, was taken from a single bone deposit, near the base of the Titanotherium Beds, not exceeding in area a space twenty feet in length by ten in width, and all from the same horizon. The locality is about three miles north of the old Brewster and Emmons Ranch, on Warbonnet creek, Sioux County, Nebraska. Front and side views of the manus are shown on Plate III, Figs. 1 and 2, and an external side view of the manus, scapula, and limb in position on Plate IV.

MEASUREMENTS.

Length of scapula	327 mm.
Greatest breadth of scapula	160 mm.

Length of humerus from proximal to distal articular surfaces	290 mm.
Greatest breadth of distal end of humerus	87 mm.
Greatest length of radius	284 mm.
Greatest breadth of distal end of radius	73 mm.
Greatest breadth of proximal end of radius	63 mm.
Length of ulna	345 mm.
Distance from anterior border of coronoid process to top of olecranon	101 mm.
Depth of ulna opposite coronoid process	91 mm.
Length of metacarpal II	111 mm.
" " " III	128 mm.
" " " IV	101 mm.
" " " V	78 mm.
Combined length of phalanges of digit II	61 mm.
" " " " " " III	61 mm.
" " " " " " IV	61 mm.
" " " " " " V	39 mm.

THE TAXONOMY OF TRIGONIAS OSBORNI.

From the above description it will be seen that *Trigonias osborni* is the most primitive and least specialized member of the Rhinocerotidæ at present known. Its generalized nature is shown alike by the tetradactyl manus, the unreduced number of superior teeth, and the simple structure of the superior premolars. It falls naturally into Series I of the American Oligocene Aceratheres as defined by Osborn, and from its generalized nature, as well as geological horizon, (base of the Titanotherium Beds), it should be considered as the most primitive form known to that series. It appears to stand directly ancestral to *Leptaceratherium trigonodum* of Osborn,[11] from which it differs essentially in the unreduced superior dentition and the simpler structure of the superior premolars, more especially of P.^{2}. When the foot structure of the other Aceratheres of this series is definitely known it will probably be found that the manus is tetradactyl in both *Leptaceratherium trigonodum* and *Aceratherium mite*, while that of *A. platycephalum* may perhaps be found to have reached the tridactyl stage. The following diagram is introduced to show at a glance the distinctive characters of the two series of American Oligocene Rhinoceroses proposed by Osborn and to indicate at the same time the geological horizon of the different genera and species contained in each. It is a modified combination of the tables introduced by Osborn on pages 126 and 129 of his memoir on extinct Rhinoceroses referred to above.

[11] See Mem. of the Am. Mus. of Nat. Hist., Vol. I, Part III, p. 126.

Horizon.		*Series I.*	*Series II.*
		$I._{\overline{2}}$ oval in cross-section and procumbent. Manus usually tetradactyl. Ancestral to the Miocene Aceratheres and the true Rhinoceroses.	$I._{\overline{2}}$ triangular in cross-section and obliquely fixed in jaw. Manus tridactyl so far as at present known. Ancestral to the Diceratheres.
Protoceras Beds.		Aceratherium platycephalum.	Diceratherium (Aceratherium) tridactylum.
Oreodon Beds.		Representatives of this series undoubtedly present, but as yet undiscovered.	Aceratherium occidentale. Aceratherium copei.
Titanotherium Beds.	*Upper.*	Leptaceratherium trigonodum.	Representatives of this series as yet undiscovered in Titanotherium Beds.
	Middle.	Leptaceratherium trigonodum. Aceratherium mite.	
	Lower.	Trigonias osborni.	

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. Crown view of left ramus (No. 97) of *Trigonias osborni*, ¼ natural size.

Fig. 2. Side view of left ramus (No. 97) of *Trigonias osborni*, ¼ natural size.

Fig. 3. Crown view of superior teeth (No. 100) of type of *Leptochœrus quadricuspis*, twice natural size.

Fig. 4. Crown view of superior teeth of *L. gracilis*, twice natural size. After Marsh.

Figs. 5 and 6. Crown view of dental plate (No. 104) of *Platacodon nanus*, three times natural size.

Fig. 7. Crown view of superior molar (No. 99) of *Orohippus* ? sp. Natural size.

Fig. 8. View of dermal impression of *Claosaurus annectens*, preserved on block of sandstone (No. 105). Natural size.

PLATE II.

Fig. 1. Side view of skull (No. 96) of *Trigonias osborni*, ¼ natural size.

Fig. 2. Crown view of superior dentition (No. 98) of *T. osborni*, ½ natural size.

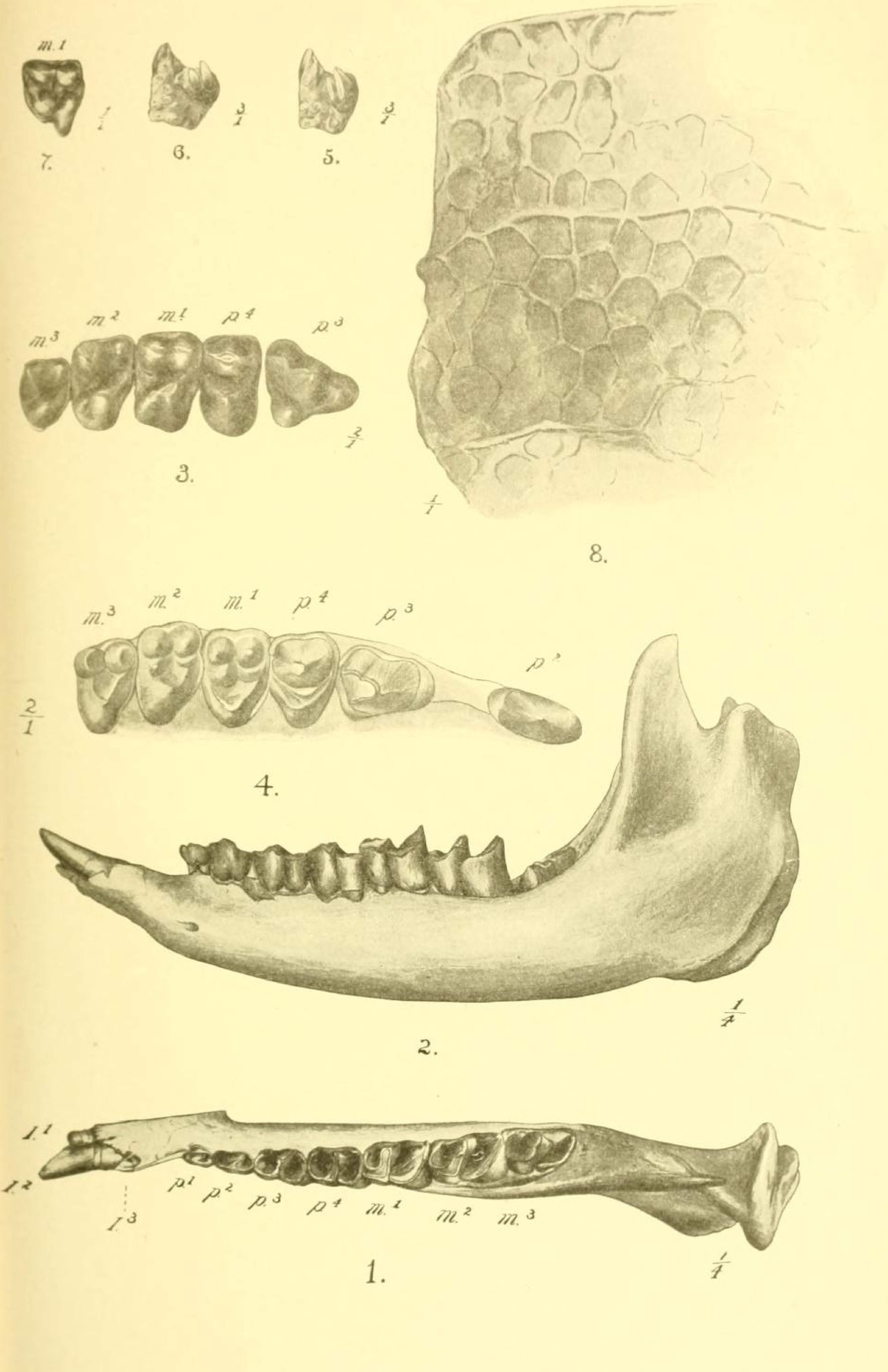
PLATE III.

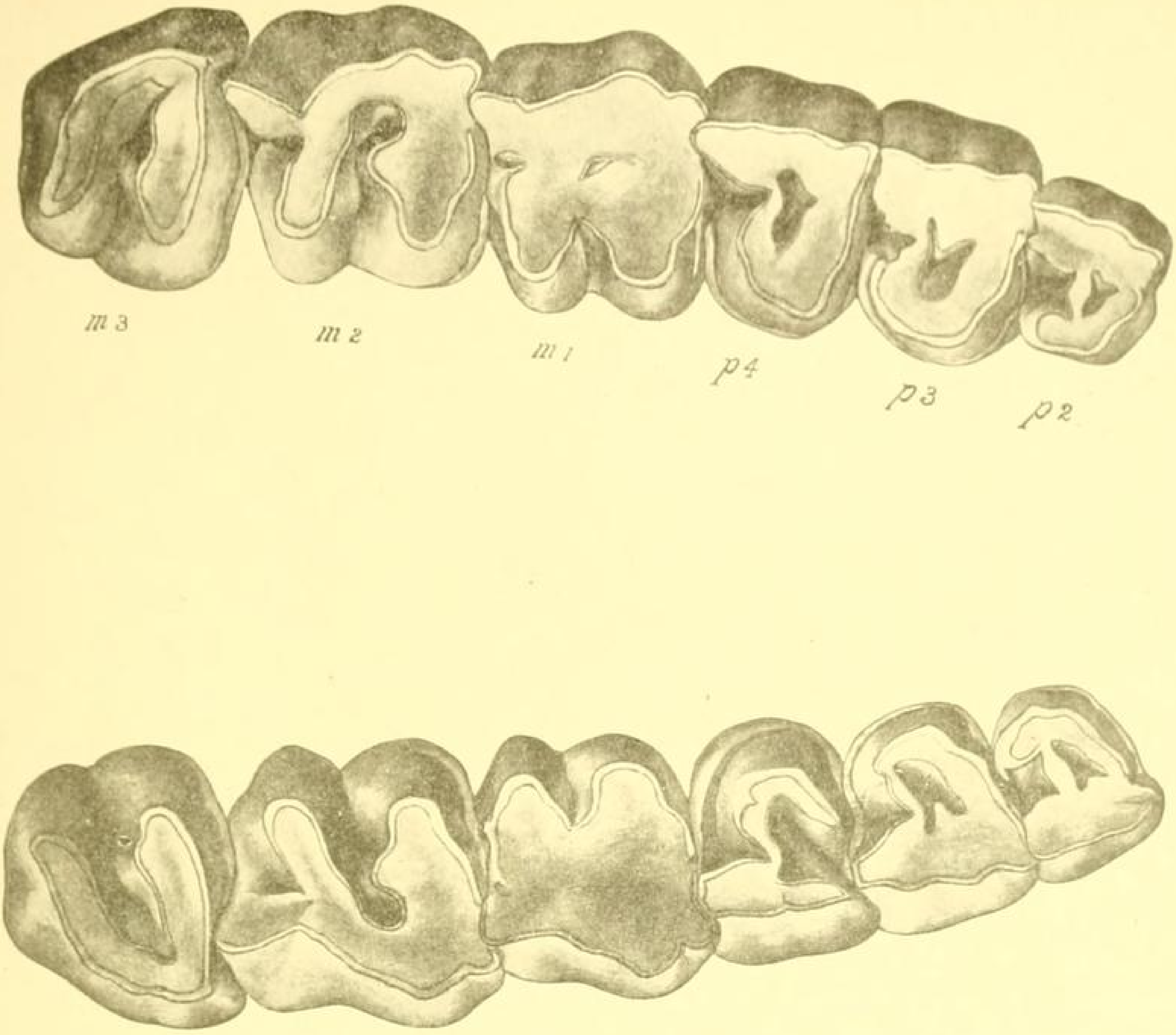
Fig. 1. Oblique front view of right manus of *Trigonias osborni*: *s*, scaphoid; *l*, lunar; *py*, pyramidal; *td*, trapezoid; *m*, magnum; *u*, unciform. A little less than half natural size. From a photograph.

Fig. 2. Inner side of right manus of *Trigonias osborni*: *pi*, pisiform; *s*, scaphoid; *l*, lunar; *tm*, trapezium; *td*, trapezoid; *m*, magnum. About one half natural size. From a photograph.

PLATE IV.

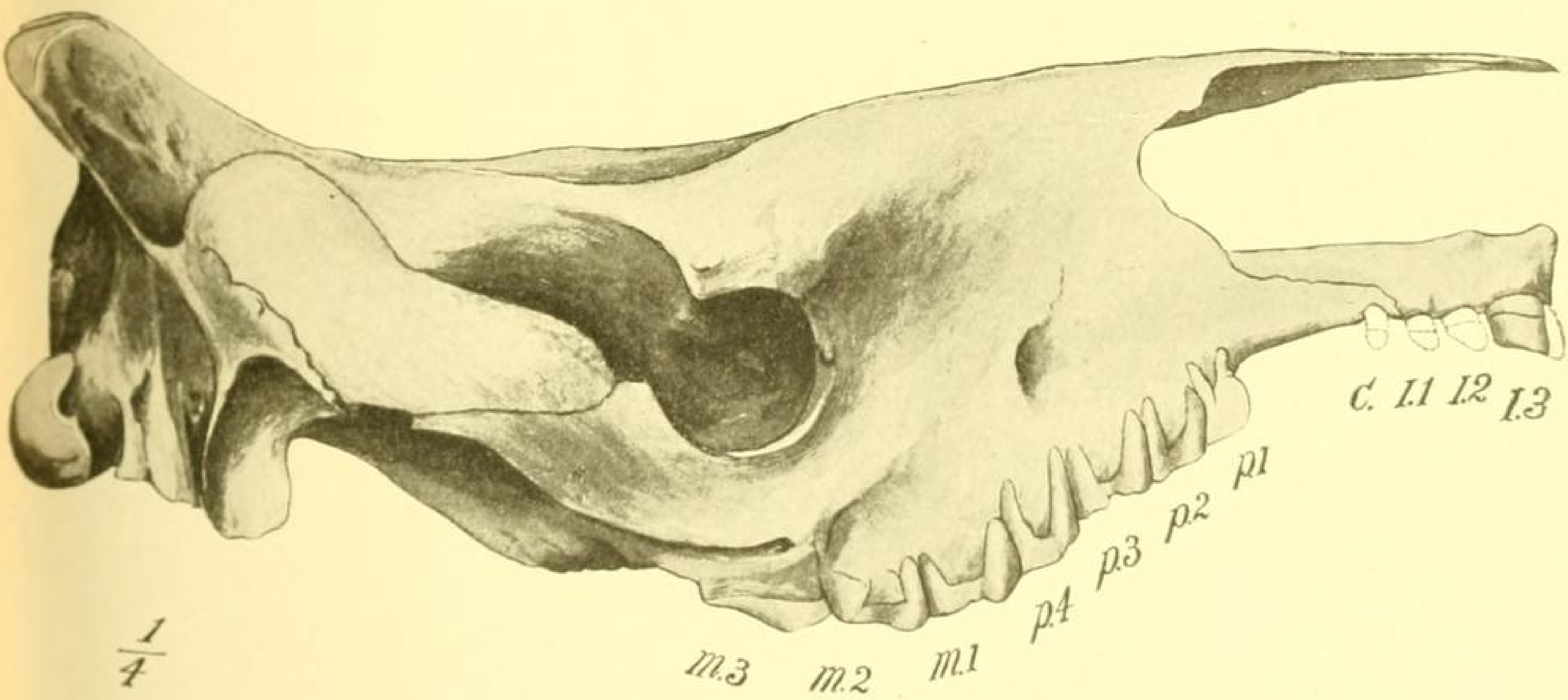
Fig. 1. External side view of right scapula, limb and manus of *T osborni* in position. About $\frac{1}{7}$ natural size. (From a photograph.)


m. 1
7.
6.
5.
m. 3 m. 2 m. 1 p. 4 p. 3
3.
8.
m. 3 m. 2 m. 1 p. 4 p. 3 p. 2
4.
2.
I. 1
I. 2
I. 3
p. 1 p. 2 p. 3 p. 4 m. 1 m. 2 m. 3
1.



1/2

2.



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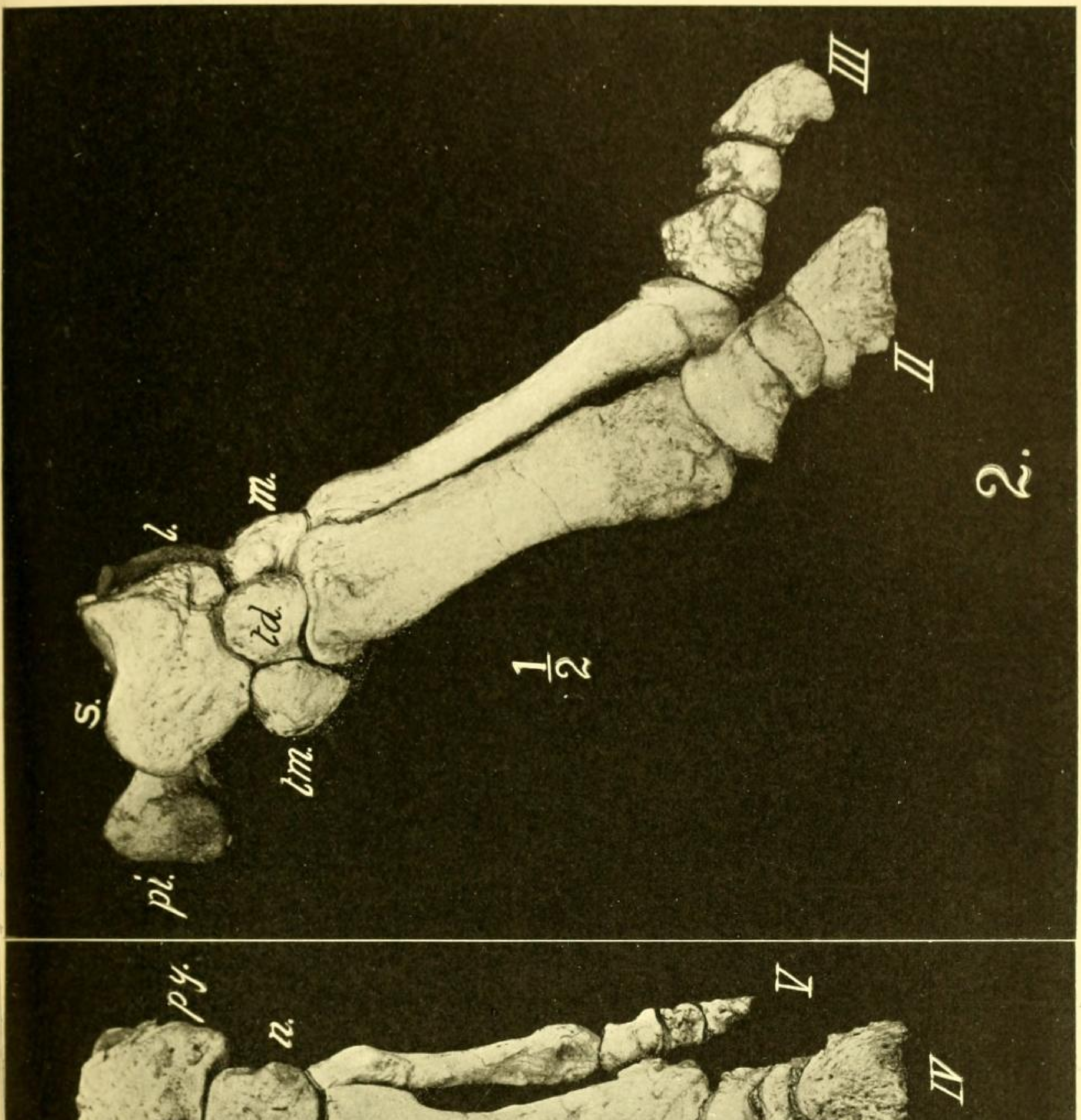
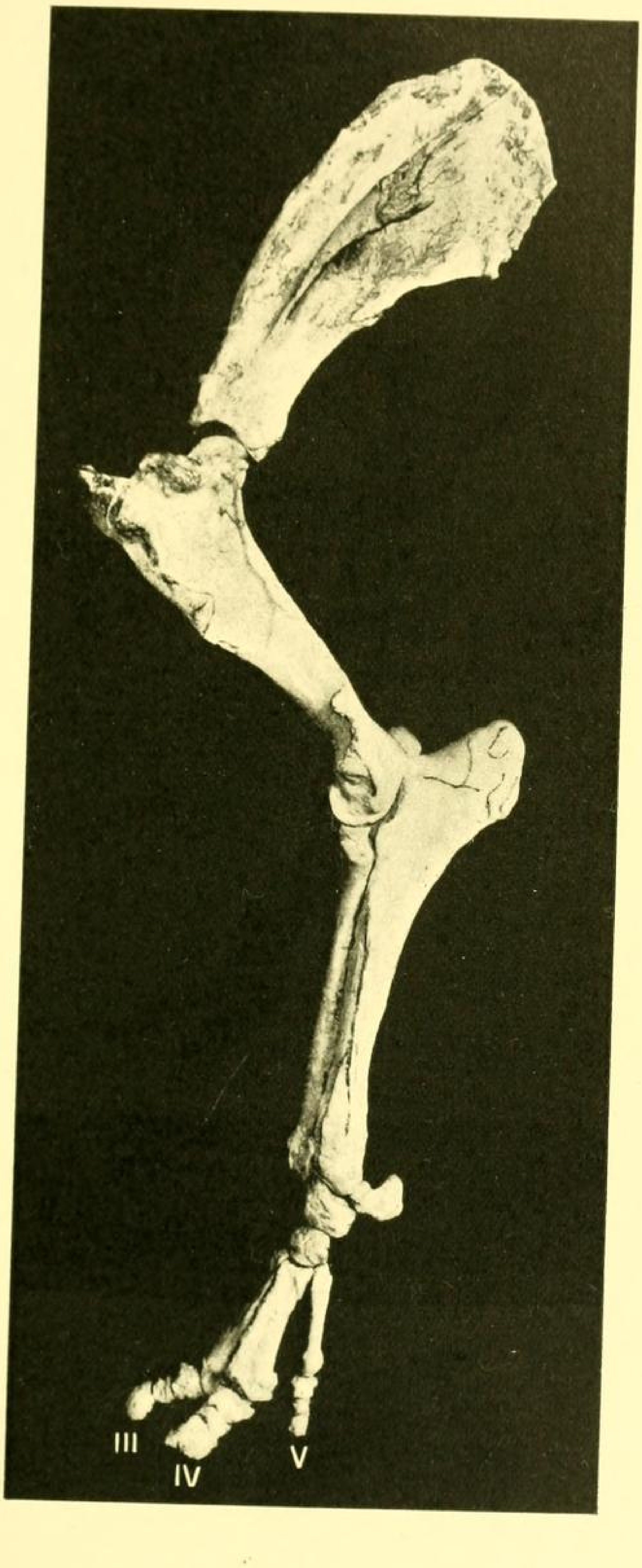
1.

Trigonias Osborni Lucas.



Trigonias Osborni Lucas



Trigonias Osborni Lucas.