

THE OTTAWA NATURALIST

VOL. XXVII

MAY, 1913

No. 2

THE MANUS IN A SPECIMEN OF TRACHODON FROM THE EDMONTON FORMATION OF ALBERTA.*

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The present paper has particular reference to the osteology of the front feet, or hands, of a specimen of *Trachodon* discovered last summer in the Edmonton formation (upper Cretaceous) of Red Deer river, Alberta, by the Geological Survey vertebrate palæontological field party under Charles H. Sternberg. This specimen is now being mounted in high relief preparatory to being placed on exhibition in the museum of the Geological Survey, Ottawa.

The skeleton of this *Trachodon* is almost complete from the front margin of the snout to the sixth caudal vertebra, but the remainder of the tail is missing. This defect, however, can be remedied to a great extent in mounting the specimen as fortunately a large portion of the tail of another individual of similar size was found at the same locality and can be used to take the place of the missing vertebræ.

This skeleton was found on its right side with the head bent downward, the front legs stretched out, and the long hind legs drawn up. Although it has been subjected to considerable pressure, the effect of which is apparent, there has been remarkably little displacement of any of the bones. The specimen is being mounted in the exact position in which it was discovered. The rock is a sandy clay, mostly soft and easily cut away, but a tenacious layer of clay iron-stone coats some parts of the skeleton and is removed with difficulty. The bones have undergone a varying amount of silicification and are in parts considerably fractured.

A clear and sharp impression of the tuberculated skin is preserved to the left of the mid-line of the back, above the sacrum, for a distance of about four feet. Large polygonal tubercles,

* Communicated with the permission of the Director of the Geological Survey.

averaging about $\frac{1}{4}$ of an inch in diameter, are here seen to form oval shaped clusters, from 2 to 3 inches in maximum diameter, surrounded by small tubercles, about $\frac{1}{10}$ of an inch in average diameter, occupying the intervening spaces, which are about $\frac{3}{4}$ of an inch across.

Of particular interest is the lattice-like arrangement of the ossified tendons in three tiers, or layers, on each side of the neural spines of the back. These rod shaped tendons have been known to occur in *Trachodon*, but in no specimen, so far as the writer is aware, has their exact disposition been revealed and described. In the Red Deer river specimen of last summer's collection some of the tendons are seen to fork, or bifurcate, and their arrangement in a triple series is shewn in a very clear and perfect manner. A somewhat similar disposition of ossified tendons, in a double series, in the back and tail has been suggested in published descriptions of *Iguanodon* and *Camptosaurus*.

The Red Deer river specimen is in an excellent state of preservation as a whole, and is one of the most complete of the skeletons of *Trachodon* mounted in the museums of this continent. As it is unusual to find the front feet with most of the bones represented, and but little disturbed, a short description of them is here given. It is proposed to publish, at a later date, particulars regarding the shape and position in this skeleton of the ossified tendons, and of such other structural characters of interest as further study of the osteology of the individual may bring to light.

Of the four digits in the manus all the phalanges are represented with the exception of the terminal one of digit II. As digits III, IV and V ended distally in a hoof (or nail) carrying bone it is probable that digit II, the inner finger, bore a terminal hoof-phalanx also.

The phalangeal formula presented by this specimen is as follows:—

Digit II. . Three phalanges, the terminal one presumably a hoof-bone.

Digit III. . Three phalanges, the terminal one a hoof-bone.

Digit IV. . Two “ “ “ “ “

Digit V. . “ “ “ “ “ “

This formula differs materially from the one given by Mr. Barnum Brown in a paper entitled “The Osteology of the Manus in the Family *Trachodontidæ**” and descriptive of the fore foot of a specimen of *Trachodon annectens* (Marsh) in the American Museum of Natural History, Cat. No. 5060, from the Lance

* Bull. Am. Mus. Nat. Hist., vol. xxxi, art. x, pp. 105-107, fig. 1. New York, U.S.A., May 28th, 1912.

formation of Converse County, Wyoming, U.S.A., a specimen remarkable for the completeness of the skin impression which has been made the subject of a recent memoir by Professor Henry Fairfield Osborn.**

The phalangeal formula of the fore foot of this specimen of *Trachodon annectens* is given by Mr. Brown as being—

Digit II.....	with three phalanges, the third a hoof.
Digit III.....	“ “ “ “ “ “
Digit IV.....	“ “ “ no hoof.
Digit V.....	“ “ “ “ “

It is thus evident that this formula, as interpreted by Mr. Brown, is not applicable to the family Trachodontidæ as a whole.

In the Red Deer river *Trachodon* from the Edmonton beds the fore feet were in the position indicated in plates I and III. In removing the rock particular care has been taken to keep each bone in the exact position in which it was found, so that any observer of the mounted skeleton, or any reader of this paper, with the aid of the illustrations provided, would be in a position to interpret for himself the phalangeal formula presented. This policy of nondisturbance of the bones has been carried out in the preparation and mounting of the entire skeleton.

In both hands the metacarpals II, III and IV are grouped together in close contact, whilst the fifth metacarpal lies somewhat apart.

In the right manus the dorsal surface of digit II, and the palmar surface of the other three digits are presented to view. Owing to the pressure to which the specimen has been subjected digits IV and V have been brought to the same level as digit III. Digit II is at a higher level, directly over and pressed down on digit III.

In the left manus the palmar surface of digits II and III, and the dorsal surface of digits IV and V are uppermost. Digits II and III lie in the same horizontal plane whilst digits IV and V are at a higher level, digit IV resting on digit III.

The right ulna and radius are seen from behind, and the left ulna and radius obliquely from without and behind.

The ulna and radius in each arm, and some of the metacarpals and phalanges, shew the effect of vertical compression, to a varying extent, in an exaggerated breadth. This distortion is given in the accompanying figures, but is probably most clearly expressed in plate III, reproduced from a photograph.

** Memoirs Am. Mus. Nat. Hist., new series, vol. I, part II, Integument of the *Iguanodont* Dinosaur *Trachodon*, pp. 33-54, plates V-X, with seventeen text figures. New York, 1912.

Regarding the fore feet as webbed and adapted for swimming, the digits were most probably capable of being spread laterally to some extent, probably more than is indicated in the figure forming plate II, which is intended to represent the hand in a moderately quiescent state.

As shewn in plates I and III, the metacarpals II, III and IV of both hands are parallel to each other and pressed together, with metacarpals II and IV brought round metacarpal III toward each other; the result probably of the contraction of the skin after the death of the animal and not indicative of the proper position of these bones when the creature was alive. Mr. Brown, in figure 1 of his paper, already cited, representing the "Manus of Trachodon correctly assembled" places metacarpals II, III and IV in this position of close contact which is not, in the writer's opinion, the true position of these bones in a fore foot capable of being used with much effect in swimming.

In the Red Deer river specimen the different bones of the digits are distinctive in shape and can be recognized in each hand. Metacarpals III and IV are of about equal length. Metacarpal II is considerably shorter, and metacarpal V is less than half as long as Nos. III and IV. The distal end of metacarpal III is enlarged, but in the other metacarpals the proximal end is the larger, the difference in size between the two ends being not so great in metacarpal II. The articulating surfaces of these bones are evenly rounded.

Plates I and III shew accurately the relative position of the bones of the hands to each other as found.

Digit V has two phalanges, of which the terminal one is smaller than that of digits III and IV. It has a more rounded outline, but, as in the others, is thick proximally and thin toward the distal margin. This terminal bone is well preserved in the right hand, is in position, and is in all respects a typically shaped hoof-bone. In the left hand a fragment regarded as the proximal end of the corresponding bone of digit V is shewn slightly in advance of the first phalanx.

The hoof-bone of digit IV of the right hand was found slightly out of place, as indicated in plates I and III. The corresponding bone in the left hand was missing and has been restored in plaster.

The three phalanges of digit III of the left hand are preserved and were found practically in place as shewn. The second phalanx of digit III of the right hand was missing and has been restored from the left hand, the restoration being placed in the sacpe found between the first and third phalanges.

The only bone not represented in either of the hands is the terminal phalanx of digit II, which is shewn in dotted outline in plate II, as a true hoof-bone on the assumption that, as the other three digits bore flattened hoof-bones, it is probable that the moderately long digit II had a terminal phalanx of this nature also. Two fragments found lying near and in front of the second phalanx of digit II of the left hand may be part of the missing hoof-bone in this hand, but it was not found possible to identify them as such.

The second phalanx of digit II is a distinctly triangular bone and is preserved in both hands, where it occurs with its pointed side directed inward. A similarly shaped bone is described and figured by Mr. Brown as occurring in the manus of *Trachodon annectens* as the second phalanx of digit IV with its narrow side pointing outward.

A carpal bone is preserved in each hand, in the same position, viz., at the ulnar side of the end of the radius. In addition, a smaller carpal bone was found in the right hand, at the middle of the end of the ulna, but a corresponding second carpal was not found in the left hand.

The teeth of the *Trachodon* from the Edmonton formation, whose fore feet are described above, agree in size, shape and marginal sculpture with those of *Trachodon marginatus*, Lambe*, from the lower horizon of the Belly River formation, whose beds are exposed a few miles farther down Red Deer river to the south-east. As the marginal sculpture of the teeth is one of the principal specific characters of *T. marginatus* the specimen from the Edmonton formation is regarded as belonging to the species from the Belly River formation until evidence is obtained to prove that a specific difference exists between them.

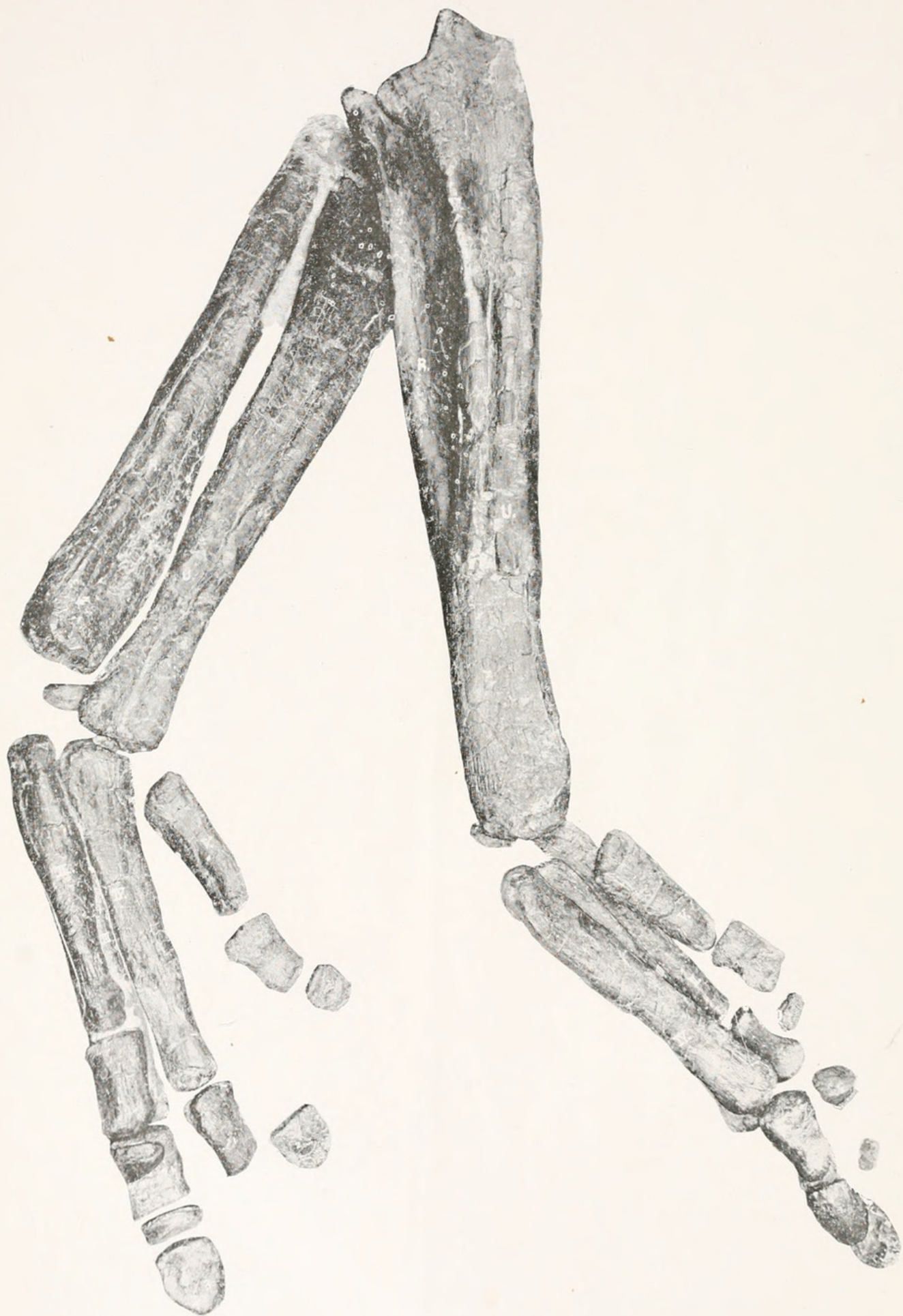
EXPLANATION OF PLATES.

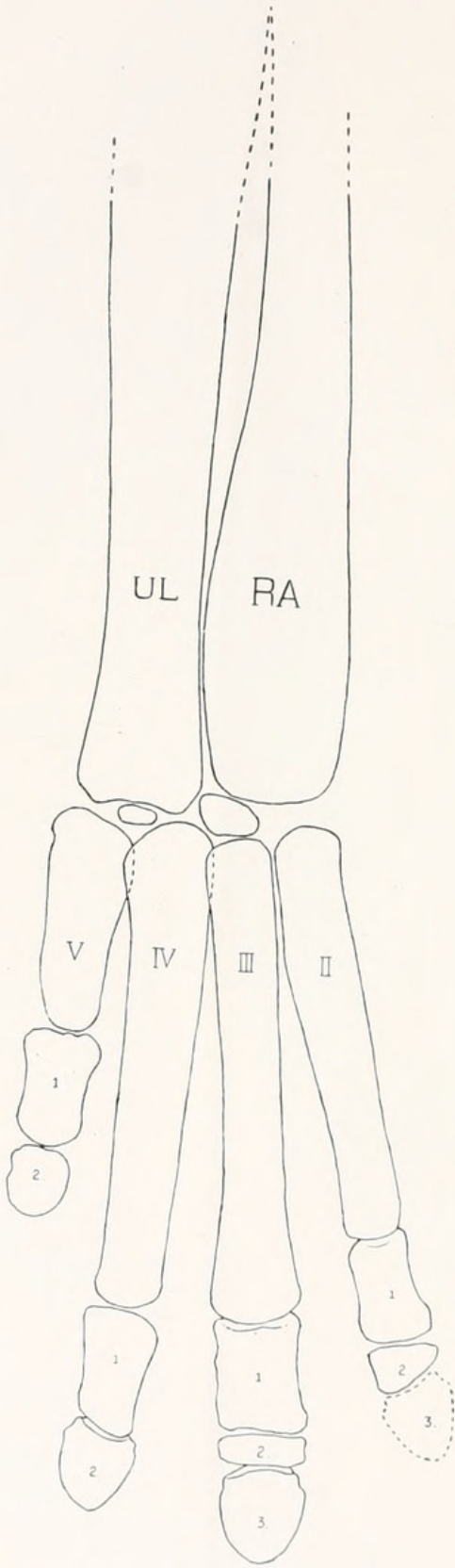
PLATE I—The fore feet of the specimen of *Trachodon* from the Edmonton formation of Red Deer river, Alberta, Cat. No. 8399, shewing the bones in the position in which they were found. One-sixth the natural size.

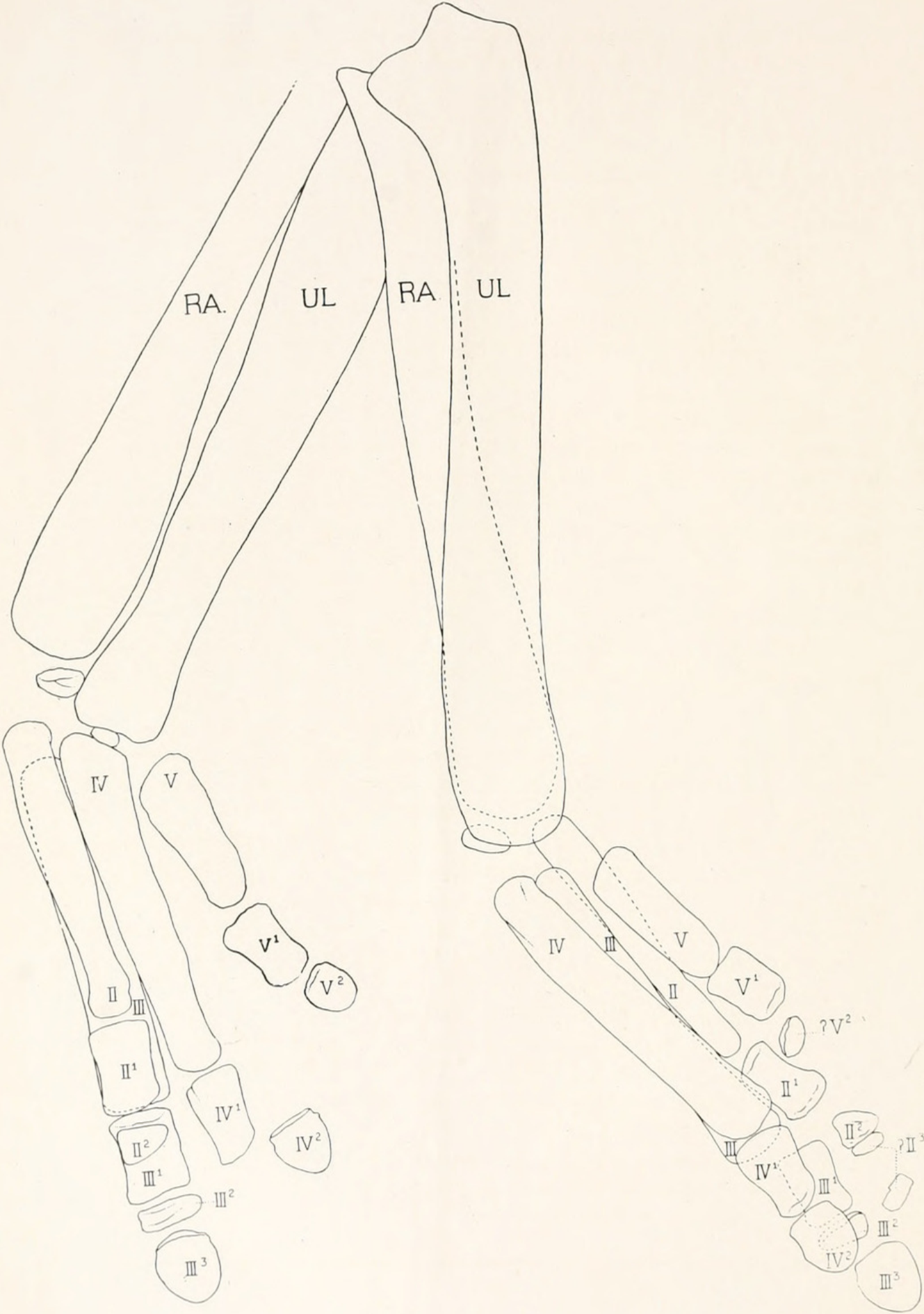
PLATE II—The right fore foot of the same specimen, dorsal aspect, with the bones in, what is considered to be, their natural position. One-sixth the natural size.

PLATE III—Reproduction from a photograph of the fore feet, of the same specimen, as mounted. One-sixth the natural size.

* Contributions to Canadian Palæontology, vol. III (quarto), part II, 1902. New genera and species from the Belly River series.









Lambe, Lawrence M. 1913. "The Manus in a Specimen of Trachodon from the Edmonton Formation of Alberta." *The Ottawa naturalist* 27(2), 21-25.

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