

APPENDIX.

ART. XXI.—*The Limbs of Sauranodon, with Notice of a new Species*; by O. C. MARSH.

SINCE the first species of the present genus (*Sauranodon natans*) was described by the writer,* eight other specimens of the same group have been discovered, and are now in the Yale Museum. In three of these, the skull is preserved, but there are still no indications of teeth, so that we may consider these reptiles as entirely edentulous. The skull shows many points of resemblance to that of *Ichthyosaurus*. The vertebrae, also, are very similar to those in that genus.

In the characters of the limbs, *Sauranodon* presents some features of special interest. The anterior and posterior limbs are well developed, and adapted for swimming. These extremities are less specialized than those in any other known vertebrate above the Fishes.

In the fore paddle, the humerus alone is differentiated. Below this, the bones of the forearm, the carpals, metacarpals, and phalanges are essentially rounded, free disks, implanted in the primitive cartilage. The radius may perhaps be regarded as a partial exception, as its free margin is nearly straight, and somewhat thinner than the remaining border. There are three bones of nearly equal size in the first row below the humerus. The radius may be identified with certainty by its position. The next bone evidently corresponds to the intermedium, and the third, or outer one, to the ulna. In the succeeding row, there are four subcircular bones, and five in the next series. These represent the carpals. There are six metacarpals, and also six well developed digits, each composed of numerous phalanges, which are all free, and nearly circular in form.

In the posterior limb, the structure is essentially the same. The distal end of the femur has three distinct facets, and of these the middle one is the largest. Next below the femur, and articulating with it, are three bones which apparently represent the tibia, intermedium, and fibula, although the first alone can be determined from its shape and position. The next row contains four rounded bones; and the succeeding one,

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five, as shown in the cut below. These correspond to the tarsals, and in the next series are the six metatarsals. There are six digits represented in this specimen. The distal phalanges are small and circular, and are left unshaded, as their exact position has not been determined.

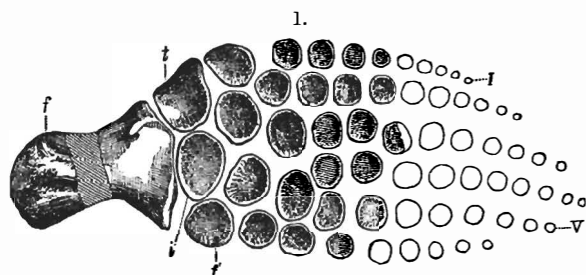


Figure 1. Left hind paddle of *Sauranodon discus*, Marsh; seen from below, one-eighth natural size; *f*, femur; *t*, tibia; *i*, intermedium; *f'*, fibula; *I*, first digit; *V*, fifth digit.

The above figure agrees essentially with the other paddles preserved, and thus may be taken to represent the typical limb in this group of reptiles. The most striking features in this *Sauranodon* limb are, the three bones articulating with the femur, and the six complete digits. These characters mark a stage of development below that seen in any other air-breathing vertebrate, and only approached by the limb of *Ichthyosaurus*. The transverse segmentation is distinct in the first five series, regarding the humerus and femur as the first segment, or propodial bones.* If the three bones of the second series (epipodials) are rightly interpreted, the middle one is the intermedium. Its position in the paddles of *Sauranodon* of both the known species indicates that its true place is in the segment where it is found. If so, it follows that in the process of differentiation this bone has been gradually crowded out of its original position between the marginal bones of the second, or epipodial, series into the third, or mesopodial, where we now find it.

* The need of general designations to apply to the corresponding segments alike of the anterior and posterior limbs of the air-breathing vertebrates is evident. While we have the convenient terms "Phalanges" and "Metapodials" for the distal parts of the extremities, there are no names in use for the portions above. Hence, the following are suggested:

| | Anterior. | Posterior. |
|-----------------|--------------------|-------------------|
| Propodial bones | = Humerus, | Femur. |
| Epipodial " | " Radius and Ulna, | Tibia and Fibula. |
| Mesopodial " | " Carpals, | Tarsals. |
| Metapodial " | " Metacarpals, | Metatarsals. |
| Phalangeal " | " Finger bones, | Toe bones. |

In *Ichthyosaurus*, the intermedium is not entirely excluded from the epipodial row; in *Plesiosaurus* and all other reptiles the process is essentially completed. In some Amphibians, this bone still separates the lower ends of the two specialized bones above it. *Sauranodon* marks an earlier and most interesting stage in the differentiation, and, taken in connection with the examples here cited, indicates clearly how the transition was accomplished.

The six complete digits in the limbs of *Sauranodon* is a character not before observed in any air-breathing vertebrate. Some of the Amphibians retain remnants of a sixth digit, and *Ichthyosaurus* often has, outside of the phalanges, one or more rows of marginal ossicles that probably represent lost digits. With these exceptions, the normal number of five digits is not exceeded.

Sauranodon discus, sp. nov.

A comparison of the various specimens of *Sauranodon* now known indicates two distinct species, which may be distinguished as follows: the type species (*S. natans*) has the facial portion of the skull much elongated, and the snout slender. The vertebræ are short, and deeply concave, in fact, almost perforate. The head of the humerus is but very slightly convex. A second specimen, which agrees in its main specific characters with the type, has a subcircular coracoid, with but slight emargination.

In the species here described, which is based upon the greater portion of a skeleton, the coracoid is more deeply emarginate, and the head of the humerus rounded, nearly as much as that of the femur. The paddles, also, are broader in proportion to their size, than in the type species, and other differences are apparent.

The present specimen indicates a reptile about twelve feet in length. It is from the upper Jurassic of Wyoming, and was found in the series of marine deposits which the writer has called the *Sauranodon* beds. This is a well marked horizon.

Yale College, New Haven, Jan. 24th, 1880.