A RECENTLY MOUNTED ZEUGLODON SKELETON IN THE UNITED STATES NATIONAL MUSEUM.

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The American zeuglodon, *Basilosaurus cetoides* (Owen) was first brought to the notice of science in 1834, when Harlan, mistaking a few fragments from the Eocene of southeastern Arkansas for the remains of a gigantic reptile, described them under the name *Basilosaurus* [1] (the king reptile). Since that time its skeletal remains have been found in comparative abundance at various localities in the Gulf States and restorations of the great beast were attempted. However, it was not until the two partial skeletons collected by Charles Schuchert, one in 1894 and the other in 1896, from the vicinity of Cocoa, Alabama, were studied and described by F. A. Lucas [2] that any accurate idea of the size and proportions of this great whale-like creature was obtained. These specimens were combined in making up the present skeleton, which constitutes the first approximately correctly assembled one of this interesting species ever to be mounted. These same bones had been partially restored and were exhibited for a number of years in the United States National Museum, but no attempt was made at that time to place them in a natural attitude, farther than to lay the vertebræ out in sequence along a shelf of one of the wall cases. This composite skeleton now occupies a prominent place in the center of the main hall devoted to vertebrate paleontology and is now the only one of its kind on exhibition in any American museum.

The skeleton, as mounted (see pl. 81), is 55 feet in length and comprises 58 elements in the vertebral column, which Lucas classified as follows: Cervicals, 7; thoracics, 13; lumbar-caudals, 38. There seems to be evidence, however, for including still one more vertebra in the dorsal series, making the number 14 instead of 13 for this region and correspondingly decreasing the lumbar series by one. Although

[1] This name, as noted by Lucas, antedates the more appropriate and better-known name, *Zeuglodon*, given by Owen. Hence *Zeuglodon* is here employed in the sense in which whale or elephant is used, as a popular name for the group.

[2] Amer. Naturalist, Aug., 1885, pp. 745–746; Proc. U. S. Nat. Mus., vol. 23, 1900, pp. 327–331.

the lumbar, sacral, and anterior caudal vertebræ are quite uniform in size and general character, there is good reason for locating the sacral region between the thirteenth and seventeenth vertebræ counting backward from the last thoracic. Not only were the vestigial pelvic bones and femur, described by Lucas, found in the rock at about this point, but these three vertebræ differ from all the others of the series in the modification of the transverse processes, which are very noticeably thickened and blunted at their outer ends, their appearance suggesting that in some remote ancestral forms these processes articulated with the pelvic bones when the pelvis was proportionately much larger than in the form represented by the present specimen.

Considering these vertebræ as sacrals, the vertebral formula for the skeleton as restored is, cervicals 7, thoracics 14, lumbars 13, sacrals 3, and caudals 21.

As already mentioned by Lucas,[1] the bones in each of these skeletons when found were lying nearly in their natural positions, so that there was little or no chance for error in again placing the elements of the vertebral column after removal from their original bed. Moreover, the specimens admirably supplement each other, the one comprising the anterior portion of the skeleton ending just behind the thoracic region includes but one lumbar vertebra which differs in the character of the transverse processes sufficiently to indicate that it is not duplicated by the first vertebra, a lumbar, of the second specimen. Hence, if any error has been made in the total number of elements included in the vertebral column, it is that they are too few rather than too many.

The skull (see pl. 82) was not complete, but as restored by the writer is given a length of about 5 feet, which length can not be far from correct, since the original parts include nearly all the posterior portion of the cranium with the glenoid fossæ intact and one complete lower ramus, which portions when properly articulate give approximately the true total length of the skull. The snout is greatly elongated and the teeth highly specialized, but otherwise the skull presents many features of the more primitive carnivores and does not in the least, except perhaps in the form of the anterior teeth, suggest any of the whales. The lambdoidal crest is greatly expanded for the attachment of heavy muscles, and the brain case is comparatively large, otherwise the posterior portion of the skull resembles in many features that of a large creodont. This has led some good authorities to believe that the zeuglodons were descendants of some branch of the creodonts.

The fore limbs (see fig. 1, p. 651) are much modified and in some degree cetaceanlike, at least as regards the scapula. The humerus is

[1] Proc. U. S. Nat. Mus., vol. 23, 1900, p. 321.

short and heavy with a well developed deltoid ridge, reaching well below the middle of the shaft. A small portion of the shaft is missing and as here restored is probably somewhat too long. This element is not at all cetaceanlike in character. The bones of the forearm are flattened laterally and articulate with each other as they do in the whales and sea lions, resembling somewhat more nearly those of the latter. The manus is not known, but judging from modifications of the radius and ulna, it was evidently highly specialized and paddle or flipper like as in the whales and sea lions. The form and arrangement of these distal elements as here restored (see fig. 1) are necessarily in great degree conjectural, the corresponding parts in both the whale and the sea lion being used as a guide in modeling them. The fact that the known forefoot elements of the closely related genus *Dourdon*, a few phalanges of which are preserved with one of the specimens (No. 4679) in the United States National Museum, resemble so much more those of the sea lions than they do those of the whales, seems to justify including more sea lion than whale like characters in restoring the paddles. Thus digit I, the hallux, is shortened, and digits II and III are made longest and heaviest of the series.

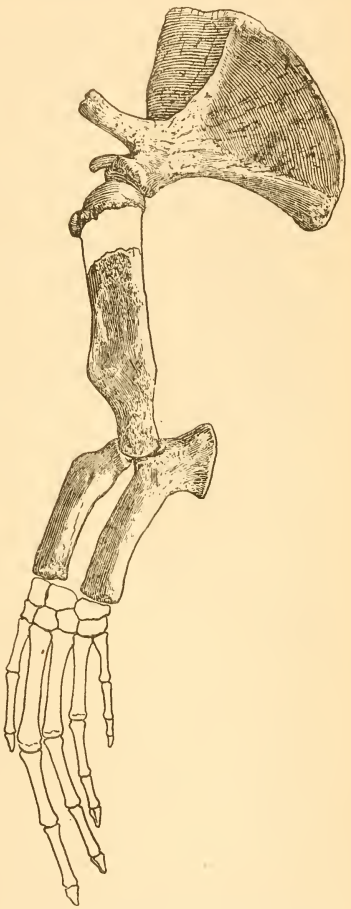

FIG. 1.—FORE LIMB OF AMERICAN ZEUGLODON. ABOUT ⅛ NATURAL SIZE.

The vestigial pelvic bones and femur, all that is known of the hind limbs, have been fully described by Lucas[1] and are mentioned and again figured here (see figs. 2 and 3, p. 652) because of the doubt which

[1] Proc. U. S. Nat. Mus., vol. 23, 1900, p. 329, pls. 5–7.

has been created as to their proper association with the skeleton to which they were supposed to belong. Abel, in an article published in 1906,[1] contended that these bones were the corocoids of a large bird to which he gave the name *Alabamornis gigantea*. A careful restudy of these elements, however, leaves no doubt as to their mammalian characteristics and no reason to assume that they do not properly belong to the skeleton with which they were found associated. While they evince an extremely atrophied state, the acetabulum plainly retains traces of the cotyloid notch and the pit for the attachment of the ligamentum teres (see fig. 2, p. 652), while the bone is considerably thickened in this region. Also, the proximal end of the femur (see fig. 3, p. 652) shows evidence of having been capped with an epiphysis. Not having the actual bones to examine Abel doubtless was led to a wrong interpretation of the plates published by Lucas, because they do not show very clearly the essential characters of the bones. This is due to the fact that the bone surfaces are pitted and roughened through imperfect preservation and the reproductions, which are from photographs, are perhaps somewhat confusing.

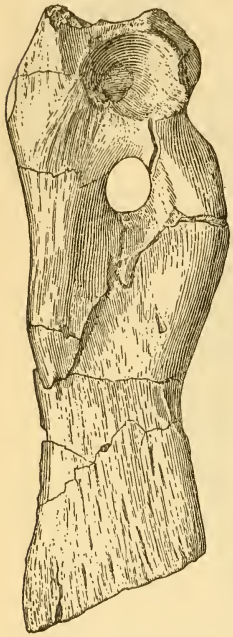

FIG. 2.—PELVIC BONE OF AMERICAN ZEUGLODON. ⅛ NATURAL SIZE.

FIG. 3.—FEMUR OF AMERICAN ZEUGLODON. ⅛ NATURAL SIZE.

The anterior portion of the vertebral column, including the cervicals and first seven thoracics, are not highly specialized and are typically mammalian in character. But from this point backward to the first lumbars, the vertebræ rapidly gaining in size and increased length of their centra, show a degree of specialization that is unique. The vertebræ from the beginning of the lumbar region to about the ninth from the end of the tail have exceedingly long, heavy centra and relatively small neural arches, and are comparatively uniform in size and general appear-

[1] Centralbl. Min. Geol. Paleont., p. 456.

ance throughout. Here the length of centra average about 15 inches, as compared with about 4 inches for the first thoracic. This gives to the skeleton a very remarkable appearance, viewed as a whole. It may be said to resemble that of a whale with an exceedingly small head, comparatively small thorax, and very greatly lengthened lumbar and caudal regions. The zygapophyses do not articulate with those of the neighboring vertebræ, except in the cervical and anterior thoracic vertebræ, and from the eighth thoracic backward to where they disappear near the end of the tail, are separated by intervals of about 5 to 7 inches, the anterior pairs being modified, apparently, for the attachment of the heavy back muscles, while the neural spines are correspondingly reduced. Thus for the greater part of the length of the vertebral column the vertebræ articulated only by their centra which are nearly circular at the ends and were probably capped by intervertebral cartilage disks of some thickness. This constitutes an arrangement which must have given to the long, slender body a perfectly free motion in almost any direction and doubtless rendered this great creature capable of diving and turning at will, or of swimming forward at tremendous speed. The short, stout, flexible neck, which doubtless was heavily muscled, also denotes agility in turning. In fact, the whole mechanical construction of the animal seems to denote that he was a most powerful swimmer, his entire development being especially adapted to rapid locomotion. If, as is indicated by the dentition, which seems admirably fitted for seizing and holding his prey, he fed on large swiftly swimming fishes, or other sea-living creatures, his very existence probably depended on speed.

It may be of interest here to recall the grotesque restoration by Koch which he constructed from zeuglodon bones and which several years ago was exhibited in various museums of this country. This restoration, which Koch called the Hydrarchos, was made up of the bones of many individuals, in which were included far too great a number of vertebræ and ribs, giving not only too great a relative length to the neck and thoracic region, but a very much exaggerated length to the whole creature. The history of this restoration is given concisely in a letter written by I. A. Latham to Prof. J. D. Dana in 1895, an extract from which is here quoted:

> I have your kind letter of the 27th asking about the Zeuglodon skeleton, lost in the great "Chicago fire." It had been brought from St. Louis some years before, and was the same discovered by Dr. Albert Koch on the plantation of Colonel Price, situated near the line of Choctaw and Washington Counties, Alabama. It was removed to Dresden in Saxony, where after eight months labor, it was reduced in length from 114 to 96 feet. It was afterwards brought back to this country and purchased by the proprietor of a museum at St. Louis, from Doctor Koch. At Chicago it was one of the chief attractions of "Wood's Museum."

Although much has been written of the zeuglodons by various investigators who have compared in detail its various anatomical features and discussed at length its relationships, there still exists wide difference of opinion among authorities regarding the true affinities of the group. One point of weakness in all these discussions is the absence of any known intermediary forms to connect them with any of the other groups to which they may seem allied.

As has been pointed out by various authors,[1] the zeuglodons possess many primitive characters, especially in the skull and teeth, in which they resemble either the seals or the more ancient creodonts. In other characters, the ones in which they are more highly specialized, they resemble the whales in some respects; while in others, as in the modification of the arm, they suggest the sea lions. There is nothing, however, to warrant placing them in any intermediate position between these at present widely separated groups of mammals, for at the time of their apparent extinction in the Eocene they had already outstripped in the development of certain important modifications what has been accomplished by any of the modern cetaceans, hence could not have stood in any direct ancestral relationship to the latter, while the primitive features which they retained are too generalized in character to especially connect them with any of the more archaic groups of mammals. Furthermore, there is at present too much obscurity concerning the origin of the whales to arrive at anything definite regarding the derivation of the zeuglodons from any ancestral form of that group.

The high degree of specialization which they had attained in the development of the body and limbs, combined with the retention of so many primitive characters, would indicate a very ancient origin for these animals, and if derived from the same stock as the seals or sea lions or direct from the early creodonts, their branching-off point must have dated back to a time most remote, certainly before the various natural groups of the creodonts appearing in the early Eocene were sufficiently differentiated to be recognized.

[1] See Thompson, On the Systematic position of Zeuglodon, Univ. Dundee, June, 1890; Dames, Paleont. Abhandl., 1894, pp. 189–219; Zittel, Grundzüge der Paleont.; and others.

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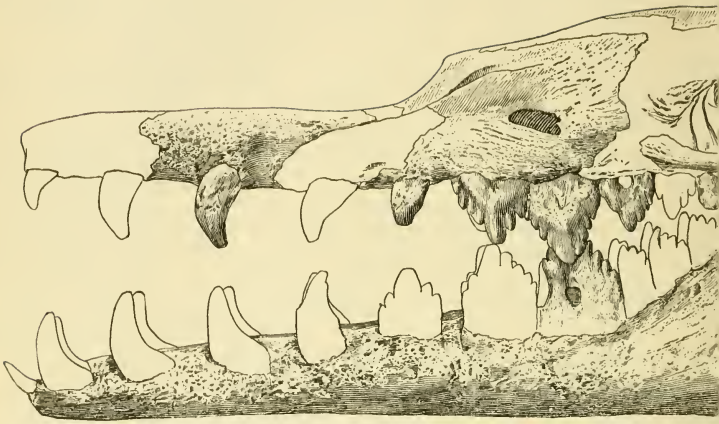

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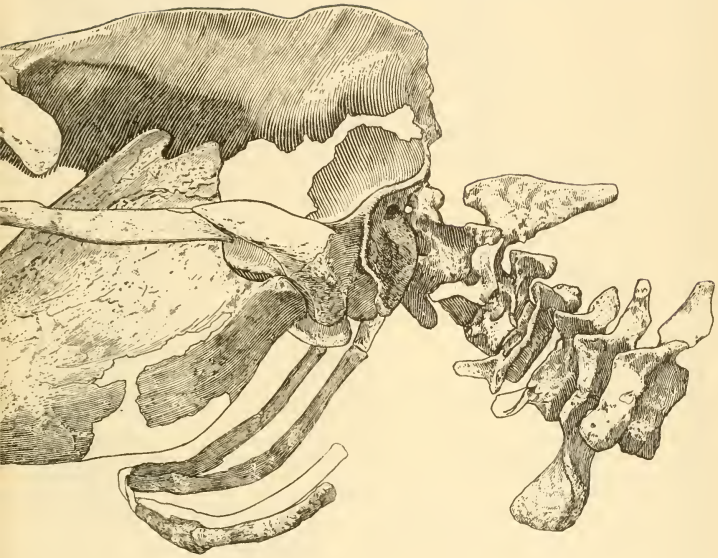

CAN ZEUGLODON. (ABOUT $\frac{1}{8}$ NAT. SIZE.)

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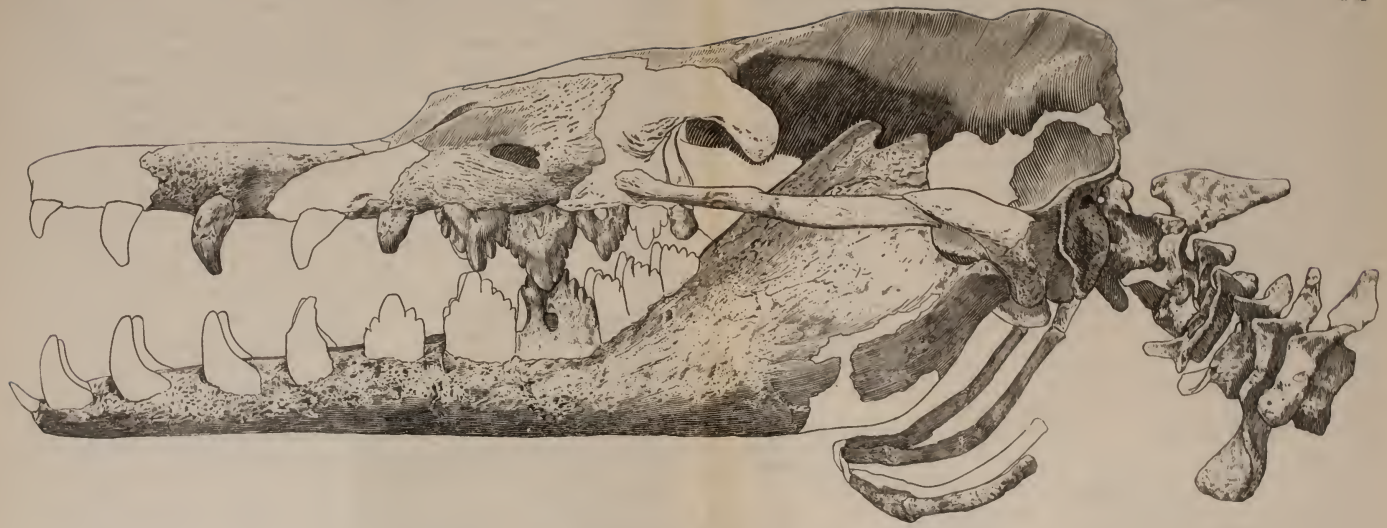

SKULL AND CERVICAL VERTEBRÆ OF AMERICAN ZEUGLODON. (ABOUT $\frac{1}{8}$ NAT. SIZE.)

FOR DESCRIPTION OF PLATE SEE PAGE 650.