ART XVI.—*North American Plesiosaurs: Elasmosaurus, Cimoliasaurus, and Polycotylus;* by S. W. WILLISTON. (With Plates I–IV.)

DURING the past two years I have had the opportunity of studying nearly all the specimens of plesiosaurs preserved in the American museums, a study undertaken in the preparation of a monographic revision of the American forms, and, it is hoped, of the genera of the world also. The accumulation, however, of material recently has made the completion of the task a more arduous one than was at first suspected. I have therefore determined to publish from time to time the more important results obtained, with the hope eventually of gathering the whole together in a final monographic revision. Furthermore, I am convinced that specimens of this order of reptiles are not as rare in America as has been believed, and hope to continue field search until the more important characters of the group have been established. I have already said, and I repeat, that the taxonomy of the plesiosaurs is very perplexing; I doubt if that of any other order of reptiles is more so, chiefly because of the fragmentary nature of much of the known material.

I desire in this place to express my sincerest thanks to those gentlemen who have generously aided me by the communication of material under their charge, and in particular to Dr. Witmer Stone of the Philadelphia Academy of Sciences, Professor Henry F. Osborn of the American Museum of New York City, President Slocum and Professor Cragin of Colorado College, and to my old friend, Mr. William H. Reed, curator of paleontology of the University of Wyoming. I am especially grateful for the generosity with which Professor Charles Schuchert, the curator of the Geological Department of the Yale Museum, has placed freely at my disposal the rich collections of that museum, collections which I had, for the most part, assisted in making a good many years ago; and to which were added many useful notes made by the late Professors Marsh and Baur, and by myself while an assistant in that museum twenty years or more ago. Professor Marsh had begun, before his death, the critical study of the plesiosaur material of the Yale Museum, and had had much of it prepared and some illustrations made. All of this has been placed at my disposal. Professor Marsh had not definitely determined any of his species, and had only tentatively located some of them in genera, aside from the Jurassic species described by him as *Pantosaurus striatus*. Most of the observa-

tions of his notes have been anticipated by myself or others; others new to me I shall fully acknowledge in each case. The present paper will deal chiefly with this material, that especially belonging to the genus *Elasmosaurus*. Other material in the collection will be discussed in later papers, so far as the more important characters are concerned.

Cimoliasaurus.

The genus *Cimoliasaurus* has been, and yet is, poorly understood. Lydekker subordinated a dozen or more generic names as synonyms, some of which have been accepted as such by later writers. Professor Marsh was inclined, as his notes show, to accept the name *Cimoliasaurus* in lieu of *Elasmosaurus* for the species now in the Yale Museum. A brief review, therefore, of the real characters of that genus, as interpreted by the light of considerable material, will not be out of place here.

The type of the genus and species *Cimoliasaurus magnus* Leidy is a number of dorsal and cervical vertebræ from Monmouth county, New Jersey, probably from rocks of an epoch corresponding with the Fort Pierre Cretaceous, and they have been, for the most part, well figured by Leidy in his "Cretaceous Reptiles." With the original specimens he later associated a series of fourteen vertebræ, or rather centra of vertebræ, from the same locality, and he speaks of such bones being common in the deposits of New Jersey. Leidy, however, sadly misinterpreted the positions of his centra in the vertebral column, nor was Cope much more correct in his interpretation of them. I would interpret figures 13–15 of Plate V of the above-mentioned work as of a posterior cervical centrum; figure 16, a more posterior cervical or early pectoral; figures 17–19, a median or postero-median cervical. Figures 1–3 of Plate VI represent a dorsal centrum; figure 4 is of an anterior dorsal, as is also figure 5; figures 6 and 7 are of a posterior cervical; 8–15, of median cervicals; 16–19, of an anterior cervical.

Leidy's description of the genus *Discosaurus* appeared on the page following that of *Cimoliasaurus*, and was based upon two caudal vertebræ from the Cretaceous of New Jersey (Plate V, figures 1–3) and an anterior caudal vertebra from the same region. Other vertebræ from the Cretaceous of Mississippi (figures 10, 11) he afterwards separated as the type of a distinct species, and was probably correct in so doing. Cope long ago showed the similitude of these vertebræ to those of *Cimoliasaurus* and made the name *Discosaurus* a synonym, in which Leidy acquiesced.

We may therefore assume that all these vertebræ, save those from Mississippi, pertain not only to *Cimoliasaurus*, but to

the type species as well; from which certain definite generic characters are evident. Cope erred in most of the distinctive characters that he assigned to the genus *Elasmosaurus*, but was correct in an important one,—the length of the neck. We shall see that in all the known species assigned to *Elasmosaurus*, of which this part of the skeleton is known, the neck is very long, and that all of its vertebræ, save the most posterior ones, are longer than broad. *Cimoliasaurus* is, therefore, a relatively short-necked plesiosaur, though not so short as in the genus *Polycotylus*. Nothing is known of the pectoral girdle or of the skull of *Cimoliasaurus*, and more decisive characters may be,—I believe will be, forthcoming when these parts of the type species are known. Unfortunately, here as among the mosasaurids, it may be a long time before the subject is cleared up finally. I am, however, firmly of the opinion that the two genera are distinct, and therefore object to the indiscriminate use of *Cimoliasaurus* in the way that it has been used, both in this country and in Europe.

While we may assume the distinction between *Cimoliasaurus* and *Elasmosaurus*, we can by no means do so for the genus *Brimosaurus*, described long ago by Leidy from a dorsal vertebra from the Cretaceous, probably Benton, of Clark county, Arkansas. I believe that this genus will comprise species now located under *Elasmosaurus*, and possibly, if not probably, the type species of that genus. For the present, however, we do know pretty nearly what *Elasmosaurus* is, and I shall therefore use this name as the designation of at least ten species of the genus known to me, so far as they can be distinguished by true generic characters. I should perhaps except one of the species described below, *Elasmosaurus (?) marshii*, because I am of the opinion that it will eventually be necessary to locate it elsewhere. Indeed I should do this now, did I not feel doubtful of its relationships to some other, as yet poorly distinguished genera.

Elasmosaurus.

The type species of *Elasmosaurus* was founded by the late Professor Cope, and based upon a specimen ascribed to the Niobrara Cretaceous of western Kansas, in the vicinity of old Fort Wallace. From the locality given for the type specimen I long ago concluded that its horizon was really basal Fort Pierre Cretaceous, and not Niobrara; and an examination of the type specimen, now in the Academy of Natural Sciences of Philadelphia, to which much of the original matrix yet adheres, confirms this determination. Though the type specimen included a large part of the skeleton, yet through some

misinterpretation of its parts by Professor Cope, and the absence of other, essential parts, it has remained until the present time not well understood. Nor is it possible yet correctly to define it in all its details, since in no one species do we know the complete skeleton ; and it is possible, even more, it is probable, that there are two or more concurrent genera among the following species, which may eventually have to

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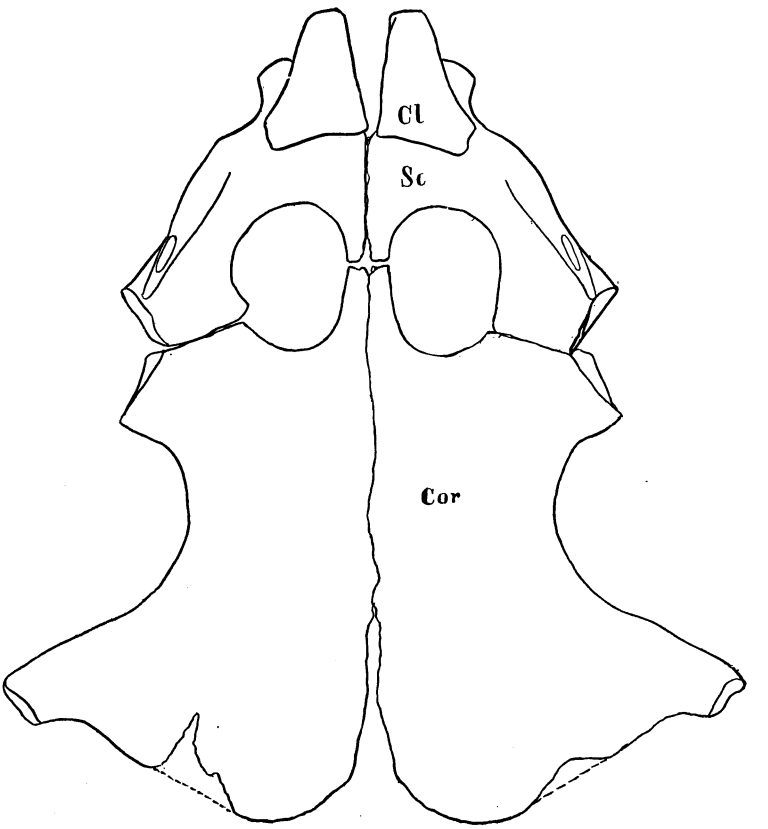

FIGURE 1.—Pectoral girdle of *Cryptoclidus oxoniensis* Phillips. From drawing of articulated specimen, American Museum of Natural History.

be distinguished from each other. Its relationships are nearest with the genus *Cryptoclidus* of Europe, a figure of the pectoral girdle of which, copied from a drawing kindly made for me from an articulated specimen in the American Museum of New York City, is given herewith (text-figure 1). But the two genera are very distinct. Indeed I am not at all sure but

they are distinguishable by more than generic characters, for the family *Elasmosaurus* is a distinct one, though its characters are not quite those assigned to it by Professor Seeley. I may add that so far, from a prolonged study of the American specimens and descriptions, I am of the opinion that no single species of American plesiosaurs can be placed in any known European genus.

Unfortunately, the type specimen of *Elasmosaurus* no longer has the girdles described by Cope. What has become of them is not known. There are some parts of these, especially the clavicular arch, that are necessary for a correct understanding of the genus. However, from an attentive study of this type specimen and of several other specimens which can be with much probability, if not certainty, referred to the same species, I am enabled to give the following characters for the genus *Elasmosaurus*. Those characters derived from the type specimen or type species are given in italics; those derived from other species referred to the genus, in roman:—

Elasmosaurus. Symphysis of mandible short; teeth anisodont. Neck with seventy-six true cervical vertebræ and three pectorals, the centra increasing in length to the fifty-eighth, and then decreasing to the dorsals; thence nearly uniform through the thoracic region; posterior cervicals and dorsals much wider than high, and wider than long; spines of vertebræ wide and not high; zygapophyses weak. Pectoral girdle with large scapulæ meeting each other in the middle line. No interclavicular foramen.

Coracoids broadly separated posteriorly to the interglenoid thickening, the posterior end not much dilated. Cervical ribs single-headed. Ischia short. Skull short; parietal crest much elevated; supraoccipital bones parial; palatines separated by pterygoids. Cervical vertebræ from sixty to seventy-six in number. Scapulæ approaching or meeting in middle line. Propodial bones short; two epipodial bones only, not wider than long; digits much elongated.

Elasmosaurus platyurus Cope. Fort Pierre Cretaceous of Kansas.

A detailed description of this specimen, in completion or correction of that given by Cope, will be given later. Certain measurements and remarks may be appropriate here.

The very broad, depressed, posterior cervical vertebræ of the posterior third, or say the posterior seven feet, prohibited much motion in the living neck, either vertically or horizontally. The motility of the neck practically ceased at the fifty-eighth vertebra. Thenceforward the neck was more slender, very slender toward the head. It was to this part that most, if

not all, motility was confined. The total length of the neck in this species in life, allowing six millimeters only for the thickness of the interarticular cartilages between adjacent vertebræ, was exactly twenty-three feet. A close approximation to the length of the trunk is nine feet; of the tail, eight feet. The length of the head, using *E. snowii* for comparison (and the remains of the type preserved show that there must have been great resemblance between these two forms in the skull), was less than two feet. The entire length of the animal in life, then, was a little over forty-two feet, an estimate somewhat less than that reached by Cope. Other specimens referred to this genus exceeded these dimensions very materially, indicating, if their proportions were alike, an extreme length of not less than sixty feet. The elasmosaurs doubtless were the longest, if not the largest, of all known marine reptiles.

In the extreme elongation of the neck, *Elasmosaurus* exceeded all other vertebrated animals of the past or present, and was, if we assume a diphyletic origin of the short-necked forms, the most specialized of all plesiosaurs, since in no other genus do we know of any species having as many as fifty cervical vertebræ. But I am rather of the opinion that the short-necked types were descendants of earlier and longer-necked forms. Unless this is the case, we know of no early plesiosaurs which could have been the progenitors of such forms as *Polycotylus* with twenty-six cervical vertebræ, or *Brachauchenius* with as few as thirteen. In their paddles, the elasmosaurs were very generalized, in that the epipodials were scarcely broader than long, and their number is but two. In the clavicular arch, *Elasmosaurus* was specialized, while in the coracoids it seems to have retained generalized characters.

As to the habits of these long-necked plesiosaurs in life, I am satisfied that they were in general scavengers, living largely in shallow waters, as well as often out at sea. Numerous remains were found the past season in Wyoming, in the Upper Cretaceous, associated with longirostral and brevirostral amphicœlian crocodiles, dinosaurs, and lepidosteal fishes, as well as with turtles of marsh or fresh-water habit. And especially noticeable was the large number of immature or quite young animals found in these deposits.

It was with a specimen of an elasmosaur (*E. snowii*) that Mudge first noticed the occurrence of the peculiar siliceous pebbles which he described; and it was also with another, a large species yet unnamed, from the Benton Cretaceous, that the like specimens were found described by me in 1892. That this habit was not confined to this type of plesiosaur, however, is certain, since I have also observed it

in different species of *Polycotylus* and *Trinacromerum*, both relatively short-necked and long-headed plesiosaurs. Much doubt and even ridicule have been thrown upon this supposed habit and the use of the pebbles by these reptiles. But the cumulative testimony of writers, both on this and the other side of the Atlantic, is quite conclusive. It has been assumed that the plesiosaurs could not have utilized the pebbles as a means of digestion in a muscular stomach. Dr. Eastman, who has vigorously opposed the idea of the possession of such a bird-like structure on the part of the plesiosaurs, seems to have been quite unaware of the fact that the modern crocodiles have a real, bird-like and muscular gizzard, and so described by Dr. Gadow. The crocodiles have a similar habit, or at least such a habit has been imputed to them, and it is not at all unreasonable to suppose that, strange as it may seem, the plesiosaurs had a real, muscular bird-like gizzard, which utilized the pebbles in whatever way the crocodiles may utilize them.

Elasmosaurus orientalis Cope. Cretaceous of New Jersey.

This species was based upon two mutilated and isolated cervical centra from New Jersey. It seems far more probable that these vertebræ really belong with *Cimoliasaurus*. Cope afterwards associated with this species an excellent series of vertebræ from the Pierre of Montana, which I have studied in the American Museum. I have not the least doubt but that Cope was in error in this collocation. I am not sure of the distinction of this specimen from *E. platyurus*, though a careful comparison of the measurements and sketches made by myself will, I think, decide their identity. If not *E. platyurus*, the species is doubtless entitled to a new specific name.

Elasmosaurus intermedius Cope. Fort Pierre Cretaceous of Montana.

This species was based upon nineteen centra without processes, and all more or less mutilated; now in the museum of the Academy of Natural Sciences at Philadelphia. I can not distinguish them specifically from *E. platyurus*.

Elasmosaurus serpentinus Cope. Niobrara Cretaceous of Nebraska.

This species was based upon much better material than was either of the foregoing ones, and it is both recognizable and distinct. Unfortunately, no figures have ever been given of the type specimen, and I have not had, so far, an opportunity to study the specimen. As in his other descriptions, Cope iden-

tified some of the vertebræ wrongly. The first dorsal vertebra, as he describes it, is in reality a posterior cervical, while his seventh is either the last pectoral or the first true dorsal. From his description, I make out sixty-two as the number of cervical vertebræ preserved, and eighteen dorsals. As this number of dorsals is smaller than is known in any other species of plesiosaurs, I am confident that the series was not complete. If Cope was correct in the serial relations of the cervical vertebræ described, the species is quite distinct from anything otherwise described. His descriptions of the pec-

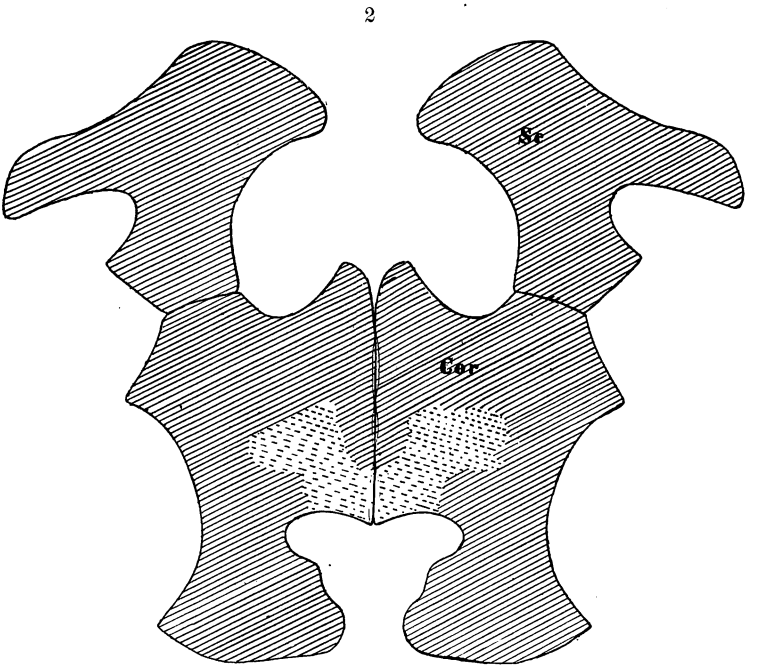

FIGURE 2.—Scapulæ and coracoids of *Elasmosaurus snowii* Williston. Specimen No. 636, Yale Museum.

toral and pelvic girdles and of the limbs indicate an excellent specimen now in the Field Museum, which will be shortly described by Mr. E. S. Riggs, and a perfect humerus from the Hailey shales in the collection of the University of Chicago.

Elasmosaurus snowii Williston. Niobrara Cretaceous of Kansas.

This species, based upon an excellent skull and a connected series of eighteen cervical vertebræ in the museum of the University of Kansas, I identify with much certainty in an

excellent specimen in the Yale collection (No. 1644), collected in 1874, by the late Professor B. F. Mudge, with my assistance, on Plum Creek, in western Kansas. It was the first specimen of plesiosaur that I ever saw. The locality of its collection is only a few miles distant from, and in almost precisely the same horizon as, that of the type specimen of the species, which was obtained from Hell Creek by the late Judge West, in 1890. Fortunately, the Yale specimen has, in addition to numerous vertebræ which quite agree with those of the Kansas specimen, parts of the girdles and limbs. I suspect that the specimen represents a somewhat immature animal; if not, it offers almost generic differences from the *E. platyurus*. The coracoids are of the true elasmosaurian type, that is, with the

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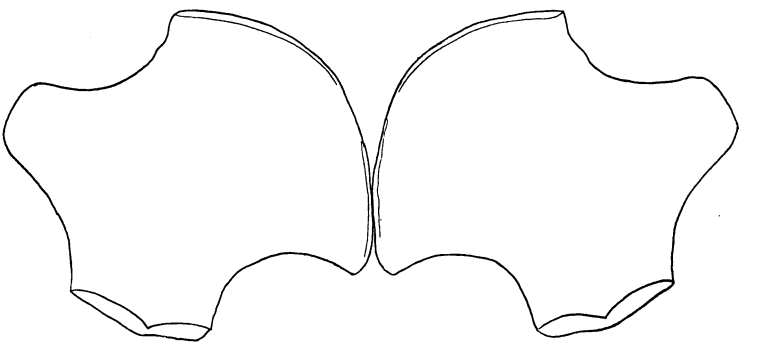

FIGURE 3.—Pubes of *Elasmosaurus snowii* Williston. Specimen No. 636, Yale Museum.

posterior parts broadly separated (text-figure 2), though this part is unusually wide and short. It has, on the other hand, scapulæ of the usual type, not very much widened in the proscapular part. The humerus is quite elasmosaurian also, resembling that of *E. ischiadicus*, though shorter (Plate III, figure 3). The pubis is, however, very distinctive, readily distinguishing the species from *E. ischiadicus*, in that the anterior and external borders are markedly concave, and the symphysial border is much prolonged (text-figure 3). Another specimen of much larger size, in Yale Museum (No. 1641), has a pubis strikingly like this, though the femur is elongated and the epipodials are short.

Elasmosaurus (?) marshii n. sp. Niobrara Cretaceous of Kansas.

The specimen upon which this species is based is No. 1645 of the Yale Museum, collected in 1889 by Mr. H. T. Martin, in the chalk of Logan county, Kansas. It consists of thirty-two vertebræ, a scapula, and a nearly complete fore limb.

The scapula, save the tip of the dorsal process, and the paddle are in excellent preservation. The vertebræ have suffered much from compression, as is usually the case with the soft-boned plesiosaurs in the Kansas chalk.

The scapula is figured in outline herewith (text-figure 4). Its inner part is greatly expanded and produced to meet its mate broadly in the middle line. At their symphysis the two bones are extended backward in a narrow, elongated process, which did not, however, unite with the coracoid, as was the case with *E. platyurus*. In front, the two bones leave a broad, angular interval for the clavicle or interclavicle. Neither of these bones has ever been certainly defined in this genus, though Cope figured the pectoral girdle of *E. platyurus*

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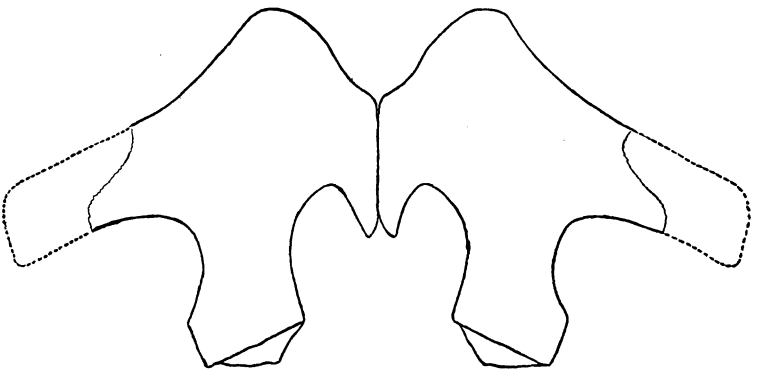

FIGURE 4.—Scapulæ of *Elasmosaurus marshii* Williston. No. 2062, Yale Museum.

as meeting broadly in front, as though the clavicle were fused with the scapulæ. I believe that the missing bone is the interclavicle, and that the clavicles will be found to be as in *Cryptoclidus*.

The structure of the paddle is clearly shown in Plate II, figure 2, as arranged under the supervision of Professor Marsh. I do not know under what conditions the bones were collected, but doubtless they were sent in from the field with the different parts dissociated. A careful study of the mounted specimen, however, assures me of the essential correctness of the restoration. The peculiar form of the humerus, quite unlike that of any other species of plesiosaur known to me, will enable this species to be readily recognized, though the characters of the scapulæ and vertebræ may possibly be insufficient. The bone is short, as is seen,—an elasmo-

saurian character, but it differs from the propodial of any other elasmosaurian known to me, in having an additional facet for a supernumerary epipodial at its distal end. There is, also, an additional mesopodial bone, which is wanting in other species of *Elasmosaurus*. These characters are, I believe, of generic value, but until the structure of the coracoid is known I leave the species provisionally in this genus. The femur has a length of 370^{mm}, and a width of 218^{mm}.

Thirty-three vertebræ are preserved with the type specimen, but as already stated they have suffered much from distortion, and their exact measurements can not be given. They are all clearly from the posterior part of the neck and the dorsal region. Some of the posterior dorsals are missing, though one of the sacrals is preserved. Their characters, so far as they are shown, are clearly elasmosaurian. The ribs are of course single-headed; the spines are broad and not very high; the posterior dorsals are more flattened at their extremities, and their articular rims are sharp, with slight crenulations. The lengths of the centra are given in millimeters, as approximately as the crushed condition will permit, as follows:—

Cervicals: 135, 135, 135, 135, 135, 135, 133, 133, 130, 127, 125, 125, 125, 120.

Dorsals: 115, 115, 115, 112, 110, 110, 100, 95, 90, 90, 90, 90, 90, 90, 90, 90, 85, 80 (sacral).

If this species had similar proportions to those of *E. platyurus*, its length in life was about fifty feet.

Elasmosaurus ischiadicus Williston. Niobrara Cretaceous of Kansas.

Polycotylus ischiadicus Williston, Field Col. Mus. Pub., Geol. Ser., vol. ii, p. 72, pls. x, xxvi, 1903.

This species, based upon the ischia, ilia, caudal and supposed cervical vertebræ, was originally referred provisionally to the genus *Polycotylus* by myself, though gravely doubting its correct location there. An excellent specimen in the Yale Museum (No. 1130), comprising the front paddle nearly complete, a number of vertebræ, and the nearly complete pectoral girdle, seems to be of the same species. I was at one time inclined to the belief that the specimen represented an undescribed species, notwithstanding the resemblance of the ischia, chiefly because of the differences in the structure of the ilia, and because of the characters of the vertebræ which I had identified as cervical. That all the centra preserved in the Kansas specimen are pygals seems hardly possible. If any of them are cervicals, the species are undoubtedly distinct. This question, however, I can not decide until I have had an oppor-

tunity of again examining the type specimen. I therefore place the Yale specimen for the present in this species.

The characters of the pelvis, that is, the short ischia especially, and the shape of the pubis, will be readily appreciated by an examination of Plate I. The paddle is especially noteworthy because of the primitive number of the epipodial bones (there are no supernumeraries), and this character I have also observed in the paddles of three other species of the genus. The paddle, it is also observed, is much elongated, and the femur is relatively short (Plate II, figure 1). The few vertebræ of the neck preserved are quite elasmosaurian in character. Other propodials of this species are preserved in the University of Chicago collections.

Elasmosaurus sternbergi n. sp. Niobrara Cretaceous of Kansas.

The only parts referable with certainty to this species are two complete dorsal vertebræ and some additional fragments in the University of Kansas collection, obtained some years ago by Mr. Charles Sternberg in the yellow chalk of Gove county, Kansas. I describe them, nevertheless, since they indicate the largest plesiosaur of which I have any knowledge. If they belonged to a long-necked form like *E. platyurus*, the animal could not have been less than sixty feet in length. That they pertain to a long-necked form is quite certain, and the general characters of the vertebræ are like those of *Elasmosaurus.*

The dorsal centra are nearly circular in outline, somewhat broader than high, with their sides gently concave. The diapophyses are stout, directed upward and outward to a plane above the zygapophyses. The zygapophyses are separated by a notch and are rather small. The spine is flattened and elongate. Figures of these vertebræ will be given in a later communication.

Width of dorsal centrum	165[mm]
Height of same	140
Length of same	80
Width of more posterior dorsal	155
Height of same	143
Length of same	78

This is the only specimen referable to this species that I have ever seen in the many years of my acquaintance with the Kansas saurians. Its extreme rarity will therefore justify the description of the rather meager material.

Elasmosaurus nobilis n. sp. Niobrara Cretaceous of Kansas.

A very large specimen referable to a new species is represented by a considerable portion of a skeleton in the Yale

Museum, obtained a good many years ago from the Fort Hays limestone, or basal strata of the Niobrara Cretaceous, of Jewell county, Kansas, by B. F. Mudge. The specimen bears the catalogue number 1640. Unfortunately, the specimen had been injured in collecting before it fell into proper hands. Originally it is probable that the larger part of the pectoral girdle, and perhaps, also, of the pelvic girdle and hind limb had been present, in addition to numerous vertebræ, and all in an undistorted condition. The specimen, notwithstanding what it has suffered, is of much interest, since it is the only vertebrate of which I have any knowledge from the Hays limestone. Additional figures and descriptions will be given later. For the present, the figures of the femur, ilia, and dorsal and sacral vertebræ given in Plate IV will render the species recognizable. A massive fragment of the scapula shows a broad and firm union with its mate in the middle line. The posterior projection of the coracoid is very long and much constricted before its extremity, its distal width being a little less than twice that of its least width; the outer posterior angle is acute and not much produced. The femur shows facets for but two epipodial bones.

Length of femur	337mm
Greatest width distally	206

A rather common species referable to this genus from the fence-post and lower horizons of the Benton is represented by a number of specimens in the Kansas University collections, and will be described later, with figures.

Two additional species also referable to this genus are known to me from the Hailey shales (probably equivalent to the Benton Cretaceous) of Wyoming, and will be described and figured later.

Polycotylus Cope.

The genus *Polycotylus*, described by Cope in 1870 from a number of mutilated vertebræ and fragments of podial bones, has remained hitherto much of a problem, and its characters have been very generally misunderstood. Fortunately, there is an excellent specimen in the Yale Museum (No. 1125), collected now many years ago by the late Professor Marsh in the vicinity of Fort Wallace, Kansas, from the Niobrara chalk, which I believe can be referred with certainty to the type species *P. latipinnis* Cope. That it belongs in the genus *Polycotylus* is beyond dispute, the vertebræ agreeing quite with the type as they do. This species seems to be the most common one of the order in the Kansas chalk, and is represented by several other specimens in the Yale Museum and by specimens in the University of Kansas collection. It is not at

all improbable that the validity of the generic name may be eventually called into question, since there seems to be no difference between the teeth of this form and that described by Leidy years before, from the Cretaceous, presumably Niobrara, of Minnesota, as *Piratosaurus*. However, as the identity must remain for many years, if not always, more or less doubtful, it would be very unwise to make any changes at the present time.

The Yale specimen, presenting as it does not a few interesting morphological and structural characters, will be fully described and figured later. It comprises the larger part of the skeleton, with the lower jaws, parts of the skull, teeth, etc. From the study of this specimen, supplemented by other specimens, clearly conspecific, the generic characters may be stated as follows:—

Polycotylus. Teeth rather slender, with numerous well-marked ridges. Face with slender beak. Cervical vertebræ twenty-six in number; dorsals twenty-eight or twenty-nine, inclusive of three pectorals; all short and all of nearly uniform length. Chevrons articulating in a deep concavity; all the vertebræ, and especially the cervicals, rather deeply concave, and with a broad articular rim. Pectoral girdle with distinct clavicles, interclavicles, and interclavicular foramen; the scapulæ not contiguous in the middle. Coracoid with a long anterior projection, united in the middle, back of the interglenoid bar, to the posterior margin; a foramen on each side, back of interglenoid thickening. Ischia elongated. Paddles with four epipodial bones, all much broader than long.

The foregoing characters, it will be seen, are very much like those already given by me for *Dolichorhynchops*, and I am somewhat in doubt as to the validity of that genus, or rather of *Trinacromerum* Cragin, of which, as I suspected, *Dolichorhynchops* is a synonym. The only important distinctions are the deep concavity of the centra and the mode of articulation of the chevrons. In none of the known species of *Trinacromerum* are there more than three epipodial bones, while in the two species referred to *Polycotylus* there are four well-formed ones. This may be, in addition to the vertebral characters, sufficient to distinguish the genera.

I give herewith some additional figures of *Polycotylus latipinnis*, made from the Yale specimen 1125 (Plate III, figure 1). The pelvic girdle, as will be seen, is remarkable for the great elongation of the ischia. The paddle figured by me in my previous paper on the plesiosaurs* was correctly assigned to the species, but is a hind paddle instead of a pectoral limb.

* Field Col. Mus. Pub., Geol. Ser., vol. ii, pl. xx.

A front paddle preserved in the Yale collection, has, as usual, the humerus more expanded distally. An outline of the coracoids and scapulæ, as preserved, is given in text-figure 5.

Polycotylus dolichopus n. sp. Niobrara Cretaceous of Kansas.

A species quite distinct from *P. latipinnis* is represented in the Yale collection by two specimens, the one a femur and most of the paddle (No. 1642), the other a humerus and some

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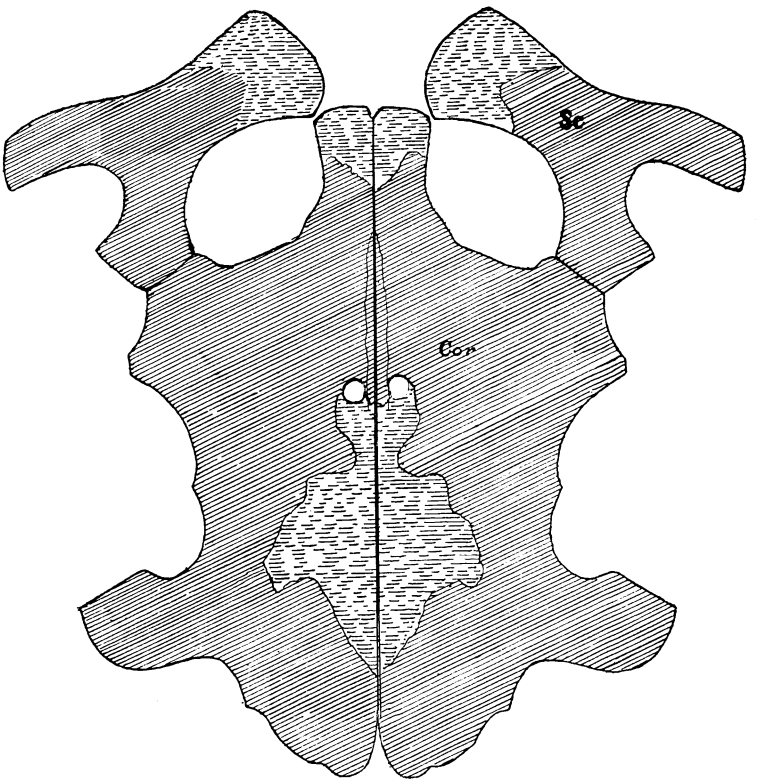


FIGURE 5.—Scapulæ and coracoids of *Polycotylus latipinnis* Cope. No. 1125, Yale Museum.

of the mesopodial and epipodial bones (No. 1646), both from the Niobrara chalk of Kansas.

I am convinced that these two specimens are conspecific, judging especially from the shape of the epipodials, but in the possibility that they may prove to be distinct, specimen No. 1646 may be considered the type of the species. The species is especially characterized by the slenderness of the shaft of

the propodials, the great transverse dilatation of the epipodials, and the markedly greater concavity of the posterior border of the propodials (Plate III, figure 2). The metapodials and phalanges are also notable for their shortness and robustness. There are four facets on the distal extremity of the propodials for articulation with the epipodials.

Length of femur (No. 1642)	311^{mm}
Greatest distal expanse	154
Length of humerus (No. 1646)	317
Greatest distal expanse	172

An additional species of this genus is known to me, and will be figured and described in a later communication.

Trinacromerum Cragin.

The genus *Trinacromerum*, if it be distinct from *Polycotylus*, as I believe that it is, is represented in the Yale collection by a considerable portion of a skeleton (No. 1129), clearly identifiable with *T. anonymum* Williston, from the Benton Cretaceous. This specimen, which offers some additional facts of interest, will be figured and described in a later communication, in connection with the description of the type species of the genus, *T. bentonianum*, which I have recently studied in the Colorado College collection.

EXPLANATION OF PLATES.

PLATE I.

Pelvic girdle of *Elasmosaurus ischiadicus* Williston. *p*, pubis; *il*, ilium; *is*, ischium. Specimen No. 1130, Yale Museum.

PLATE II.

FIGURE 1.—Right pelvic paddle of *Elasmosaurus ischiadicus* Williston. Specimen No. 1130, Yale Museum.

FIGURE 2.—Left pectoral paddle of *Elasmosaurus (?) marshii* Williston. Specimen No. 1645, Yale Museum.

PLATE III.

FIGURE 1.—Left half of pelvic girdle of *Polycotylus latipinnis* Cope. 1*a*, pubis; 1*b*, ischium; 1*c*, ilium. Specimen No. 1125, Yale Museum.

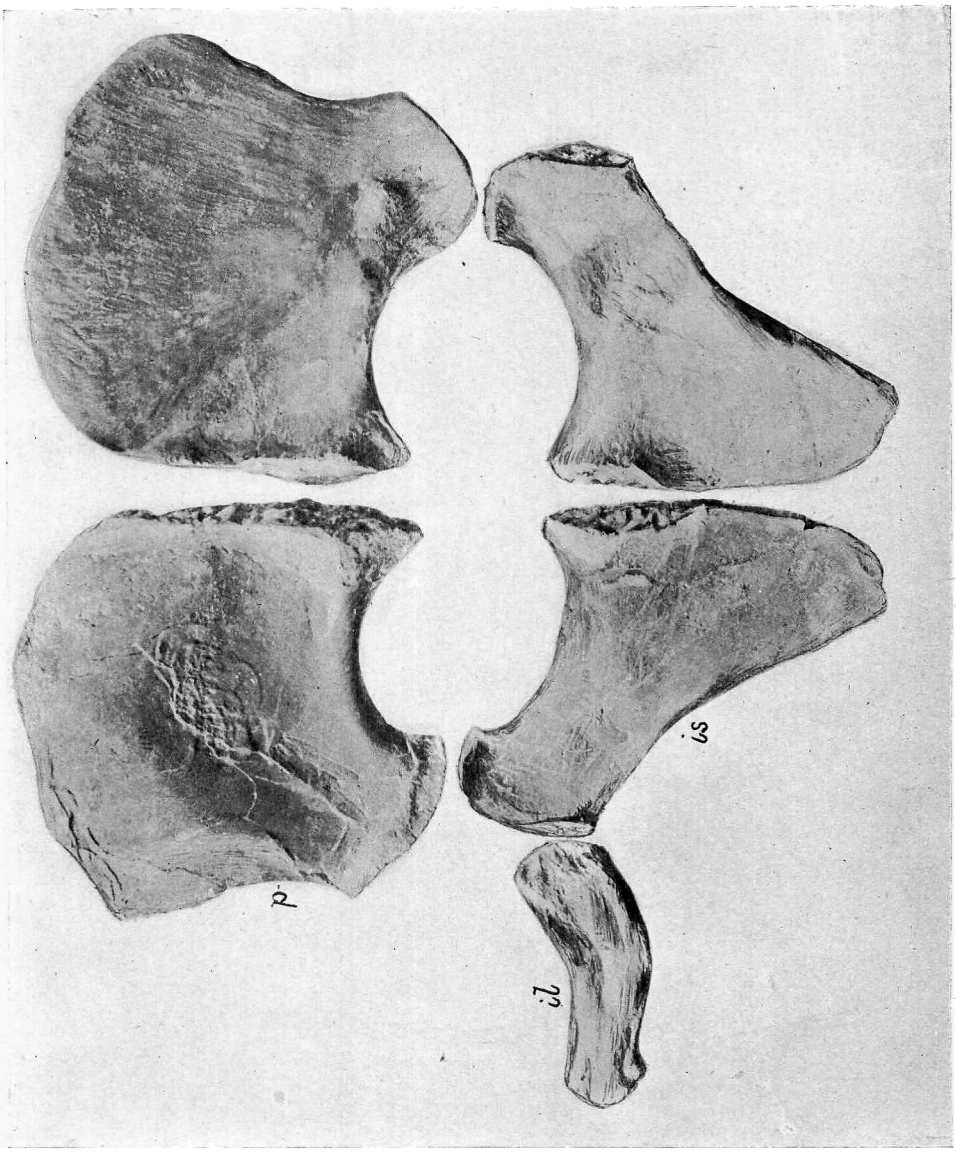
FIGURE 2.—Right propodial and epipodial bones of *Polycotylus dolichopus* Williston. Specimen No. 1642, Yale Museum.

FIGURE 3.—Right humerus of *Elasmosaurus snowii* Williston. Specimen No. 1644, Yale Museum.

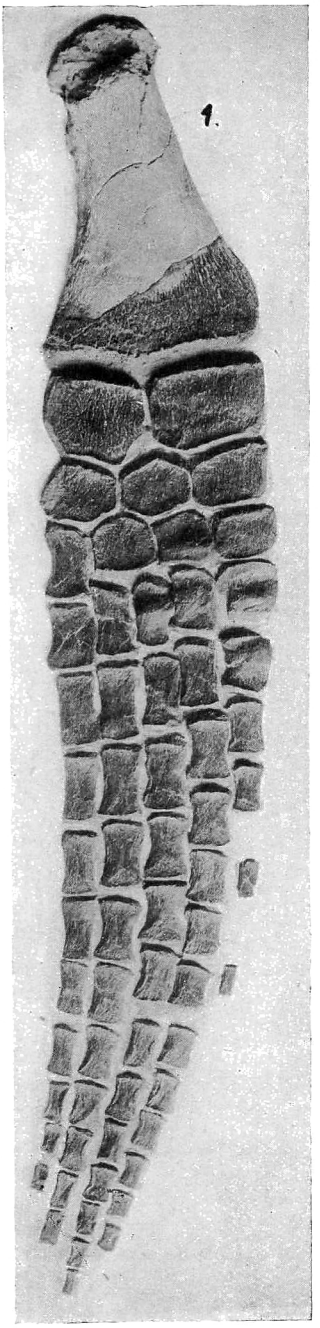
PLATE IV.

Elasmosaurus nobilis Williston. Specimen No. 1640, Yale Museum.

FIGURE 1.—Right ilium.
FIGURE 2.—Left ilium.
FIGURE 3.—Right femur.
FIGURE 4.—Posterior sacral vertebra.
FIGURE 5.—First sacral vertebra.
FIGURE 6.—Anterior dorsal vertebra.
FIGURES 7, 8.—Posterior dorsal vertebræ.
FIGURE 9.—Middle sacral vertebra.



Elasmosaurus ischiadicus Williston.



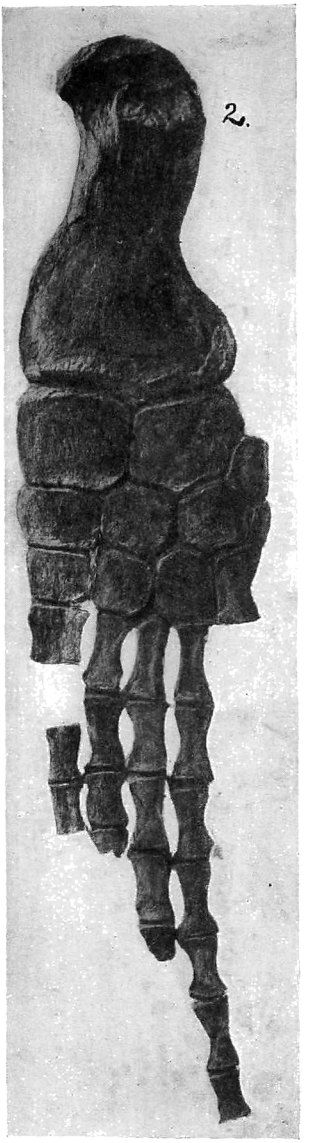


FIG. 1. *Elasmosaurus ischiadicus* Williston.
FIG. 2. *Elasmosaurus*(?) *marshii* Williston.

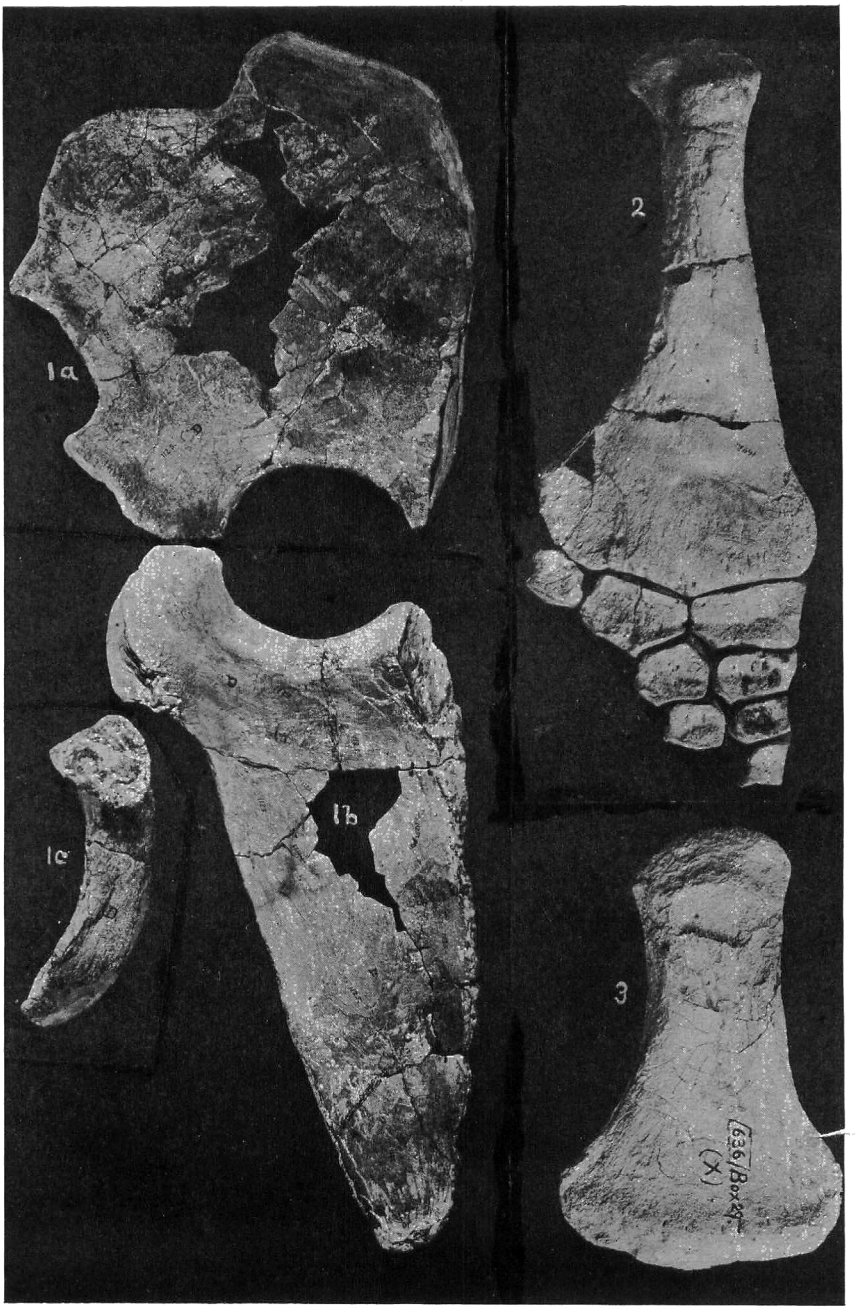
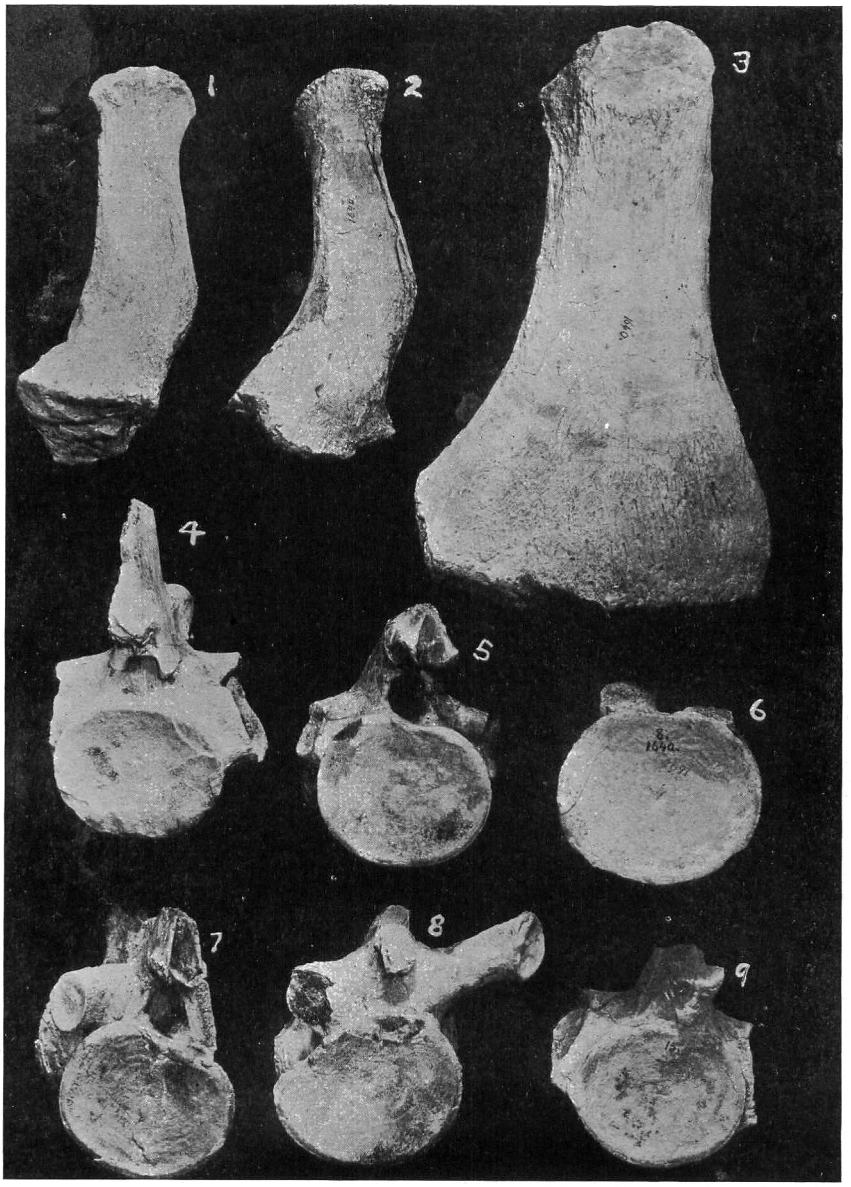


FIG. 1. *Polycotylus latipinnis* Cope. FIG. 2. *P. dolichopus* Williston.
FIG. 3. *Elasmosaurus snowii* Williston.



Elasmosaurus nobilis Williston.