2. Some Reptiles from the Niobrara Group in Kansas.

By

C. Wiman.

(Pl. II—IV.)

Introduction.

Thanks to liberal patrons, the Palaeontological Museum in Upsala has been able to acquire a rather considerable number of fine specimens of fossil vertebrates.

Among these are to be found three reptile skeletons from the Niobrara Group in Logan Co., Kansas, collected during the expedition carried out in 1918 by CH. H. STERNBERG (»The Fossil Hunter»), who is now seventy year old. Ward's Natural History Establishment of Rochester has negotiated the purchases and with customary generosity Swedish shipowners have granted free transport.

As all three skeletons are suited to increase, in some degree, our knowledge of the interesting fauna of the Niobrara Group, I will give an account of them below.

Pteranodon sp.

Pl. II.

According to CH. H. STERNBERG, the slab was found 12 miles south of Russel Springs, in Logan Co., Kansas.

The reason of the specimen offering a certain interest is that it presents a fragment of the fibula. Farthest to the right of the plate, at the downward turned upper end of the tibia, is seen a hook-like projection which can hardly be anything else than a fragment of a fibula, the rest of which is destroyed. In text figure 1 the bone is reproduced with the right end upwards.

In EATON's large monograph on *Pteranodon* (1, p. 35), published in 1910, it is stated that »there is no trace of any fibula» either in *Nycto-*

saurus or *Pteranodon*. From here the statement has crept into current hand books, e. g. Zittel's Grundzüge (13, p. 356). This statement may, however, be due either to an oversight, or else to the fact of the bone in question always having been destroyed in the large number of specimens that have been at the disposal of the American investigator.

However, it is not the first time that a fibula has been noticed in *Pteranodon*, for the very same year, 1910, in a work on *Platecarpus*, S. W. WILLESTON says: »Incidentally I may mention that in *Pteranodon* among pterodactyles the fibula is supposed to be absolutely wanting, yet in a specimen in our collection I find distinct remains of it fused with the tibia» (10, p. 540). No figure is given, and it is, of course, obvious that the statement has been overlooked.

From the adjoining Fig. 1, it is evident, partly that a fibula has really existed in *Pteranodon*, and partly that at its upper end it has been fused with the tibia, perhaps in such a way that it has not articulated against the femur. It is stated (1, p. 35) that no »tibial articulation» for the fibula against the tibia is supposed to exist. There is given, for comparison, a figure, according to OWEN (8, pl. 20 fig. 1), of the corresponding parts in *Dimorphodon macronyx* from the lower Lias of Lyme Regis.

Because of the above quoted observation, there may be some probability, firstly, that the fibula has existed in all cretaceous flying-lizards and, secondly, that it has had about the same appearance and stood in much the same relation as in *Dimorphodon*.

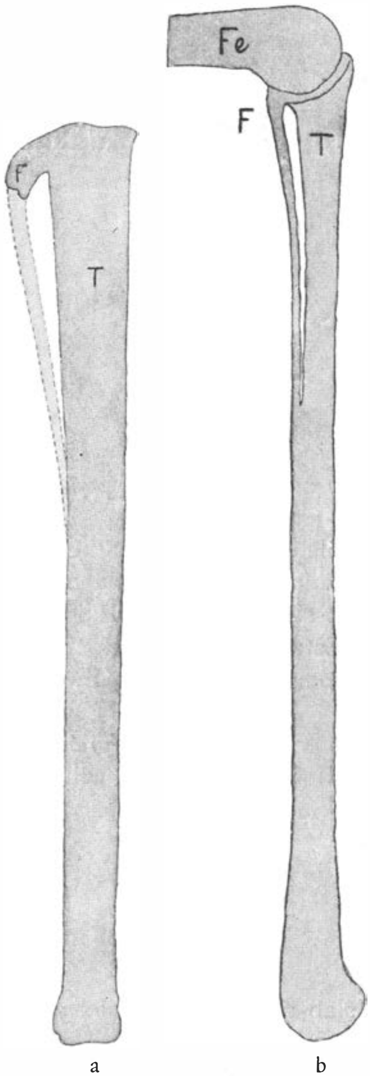

Fig. 1 a. Tibia and fibula of *Pteranodon sp.* reduced to $^1/_2$.
b. Same parts of *Dimorphodon macronyx* (after OWEN). Natural size.

Platecarpus coryphæus.

Pl. III.

With regard to the specimen of *Platecarpus* here reproduced, Mr. CH. H. STERNBERG has had the kindness to give the following information: »*Platecarpus coryphæus* consists of Nos. 16 and 30, same-sized individuals.

No. 16 Butte Creek, Logan Co., Kansas, found by LEVI STERNBERG, consisting of head and column with ribs to near pygals. No. 30, entire tail and pelvic arches, pygals and hind paddles. Locality: 3 miles south-east, mouth of Beaver Cr., Cove Co., Kansas, found by GEORGE F. STERNBERG. The front paddles were from two different specimens, one found near No. 30. Unfortunately I cannot remember exactly where in the column the No. 30 begins, but believe, with the specimen before you, you can tell exactly. From Note Book 1918.»

From the specimen it is evident that the tail is coherent and

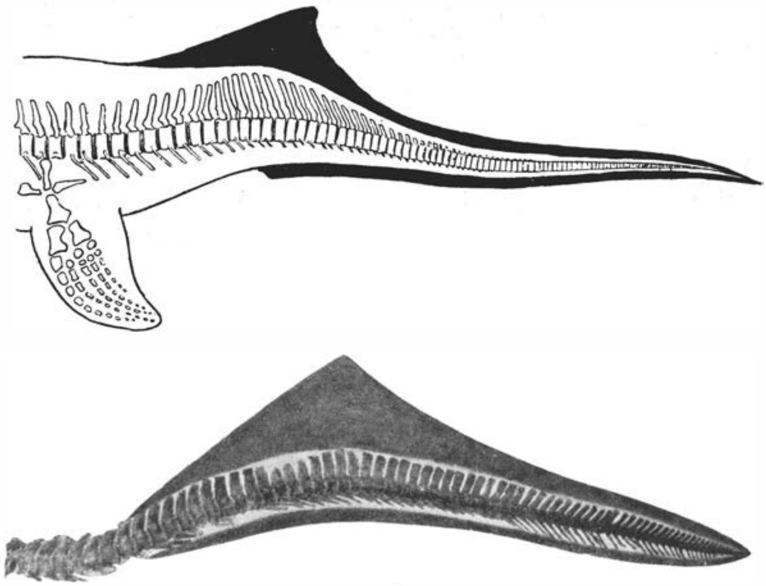

Fig. 2. Above: Caudal fin of *Phalarodon Nordenskiöldii* (after *Wiman* from FRAAS (3 p. 486 fig. 2) Below: Caudal fin of *Platecarpus coryphœus*.

undisturbed from the posterior end to far in front of the critical point, the tail-curve, which gives rises to the following speculations:

Even when unpacking the specimen reproduced here I was struck by the great similarity of the tail curve to that of the triasic Ichthysaurians (12, pl. 6 fig. 1) which I had previously studied. The tail of a specimen of a *Clidastes* species, of which I will give an account below, has also the same shape, and it can hardly be a mere chance that the same pecularities are found just in the two Mosasaurian tails at Upsala that have the tail-curve undisturbed, but it may be, instead, that the tail curve always exists, but on account of its small amount has been overlooked and (or) removed when mounted. The slight discontinuity in the elevation of the neural spines, which is clearly discernible in a figure of a *Platecarpus*, presumably *abruptus* MARSH, published by WILLISTON (10, p. 538 and 11, p. 151), indicates that a small curve on the tail has been removed in the mounting.

If I am correct in my interpretation, then, at least, certain Mosasaurians would have developed a caudal fin similar to that of the Ichthyosaurians and Thalattosuchians. *Platecarpus coryphæus* and *Clidastes Sternbergii*, the two forms under consideration here, would in this respect not have got farther than the Triassic Ichthyosaurians, for instance, *Phalarodon Nordenskiöldii*, *Mixosaurus cornalianus* and *Cymbospondylus petrinus*. *Tylosaurus* was formerly also reproduced with a straight tail (9, Pl. 72). Since 1899, however, this type is represented (7, p. 186) with the tip of the tail bent downward, much the same as in an Ichthyosaurian from the lower Jura. As in these, so in *Tylosaurus* no discontinuity in the development of the neural spines above the tail-curve is discernible.

In the above-mentioned figure by WILLISTON, there is certainly a

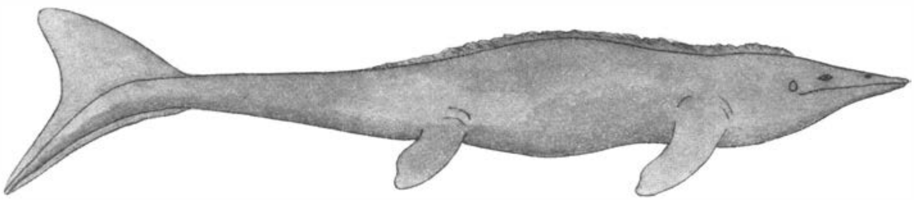

Fig. 3. New reconstruction of *Tylosaurus*.

similar discontinuity, but this is only on account of the tail-curve having been removed when mounted or drawn.

There is, however, one difference between *Tylosaurus*, on the one hand, and the fullgrown lower jurassic Ichthyosaurians, on the other, viz., that there is no sharp rupture on the tail of the former; but there is none in the young one of the lower jurassic *Stenopterygius quadriscissus* either, reproduced by FRAAS (3, p. 486 fig. 3). Likewise the tail curve seems to be less sharp in *Geosaurus* (2, Pl. 7, fig. 7), where the dorsal fin of the tail is marked by a discontinuity in the development of the neural spines, and is, moreover, verified by so-called hide specimens.

Because of the above and although the curve is more continuous, I consider it probable that *Tylosaurus* has had a caudal fin similar to that of the Ichthyosaurians and Thalattosuchians.

It seems to me that a soft, flabby skin flap, as in KNIGHT's reconstruction published by OSBORNE, is without meaning from a locomotory point of view, and cannot explain the downward bend of the tail.

Clidastes has usually been reconstructed with an oval paddle on the tip of a straight tail. There seems to be no reason for assuming the existence of this paddle, but it may be a foreign loan from the sea-snakes, suggested perhaps by the misleading name of Pythonomorpha.

Clidastes Sternbergii n. sp.

Pl. III.

The specimen bears the expedition number 24, and, according to the label, constitutes a *Clidastes* n. sp.; it comes from Beaver Creek, Bilby's Ranch in Logan Co., Kansas, and has been collected by LEVI STERNBERG. All the parts belong to one specimen and to a great extent lie undisturbed.

The last three cervical vertebrae and the two foremost thoracic vertebrae of the vertebral column are much restored and a transposition has evidently taken place here in connection with the mounting of the head, apart from which there has been no displacement within the coherent parts of the vertebrate column.

According to a statement by CH. H. STERNBERG, the ribs are undisturbed, as can also be seen from the specimen.

STERNBERG fixes the size of the preserved part of the head at 39,4 cm. A part of one maxilla is missing and the entire praemaxilla as well. The cranium has largely been restored in such a way that those parts which really have been preserved are covered with plaster and cannot be verified. The teeth are artificial. To what extent the cranium is reliable may be seen from the description and figures. The bones of the extremities are partly transferred on plaster.

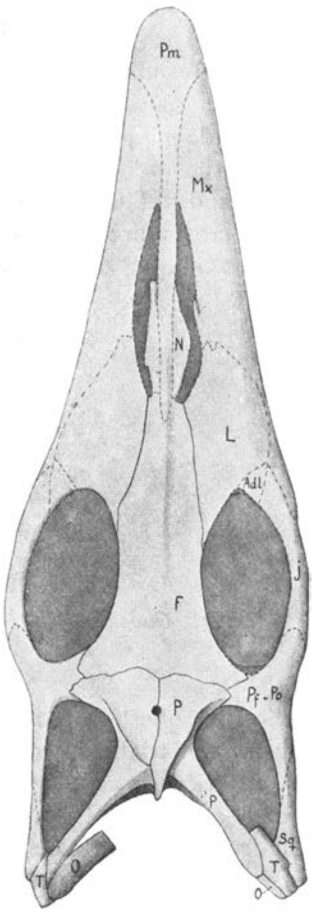

Fig. 4. *Clidastes Sternbergii* Cranium. Pm = Praemaxillare, Mx = Maxillare, N = Nasale, L = Lacrimale, Adl = Adlacrimale, J = Jugale, F = Frontale, Pf + Po = Postfrontale + Postorbitale, O = Opistoticum, T = Tabulare, Sq = Squamosum. Red. to $^1/_3$

I have hesitated as to whether I ought to describe the specimen as a new species, because it is not likely that the American literature on the subject has yet had time to master the whole of the colossal material which is to be found heaped up in the museums, and the supplies of American literature sent even to the neutral countries have been very incomplete during recent years.

It seemed wrong, however, not to give some information regarding an interesting specimen that I have removed so far away from the rest of the material of American Mosasaurians.

The entire animal measures 2,65 m. in length.

The head is 11 cm. wide across the hindmost part of the squamosa and from the connecting line between the back parts of the tabularia to the tip of the nose 34,5 cm. Thus the relative figure between length and breadth is somewhat more than 3. The corresponding figure for *Clidastes velox* is somewhat less than 3 and for *Tylosaurus proriger* somewhat still less than 3.

In the middle line of the head, the parietale is only 4,8 cm. long and thus comprises not quite $^1/_7$ of the length of the entire head. The corresponding figure for *C. velox* is about the same. The relation between the length and breadth of the parietale is also about the same in both species and yet this bone has in both species quite a different character, as the crests are almost parallel in *C. velox* and even diverge backwards, while on the contrary they converge and meet posteriorly in the

Fig. 5. *Clidastes Sternbergii.* Quadrata, left and right, seen from outside. Natural size.

species in question, so that, conjointly with the front edge of the bone, they form a triangle much the same as in *Platecarpus coryphæus*, although the posterior corner of the triangle does not reach so far back in the latter species as in the Upsala *Clidastes.* This is, of course, a deviation from what is usually the case in *Clidastes.* The foramen parietale is small and lies on the boundary between the first and second third of the parietale, thus considerably farther back than in *Clidastes velox* and other Mosasaurians. A similar position is found again in the varans.

The posterior projections of the parietale towards the tabulare (= Supratemporale auctorum) are quite intact and do not present anything worthy of remark, and the same holds good with regard to the tabulare and the opistoticum, so far as these bones are visible. The squamosum, on the contrary, is somewhat restored, so that the foremost boundary on the temporal arch cannot be observed. The frontale has about the same shape as in *C. velox*.

As regards the rest of the bones of the cranial roof, the boundaries are, on the contrary, uncertain. The posterior edge of the lacrimal, in particular, may be incomplete, so that the orbit, seen from above, has become too large. The shape of the nasals is indicated, but I do not know if the boundaries are to be relied on. The quadratum resembles in shape a human ear with the point turned forward. In the middle, where it is broadest, it measures 27 mm, and has a height of 39 mm. A rectangle within which the bone might be fitted measures 30×40 mm. The most striking feature is the strong development of the infracolumellar process. The supracolumellar process presses against the upper part of the latter in such a way that the columellar canal (meatus auctorum) is entirely closed up. The canal itself lies so far back that it is hardly visible in the figures. As the condyle against the squamosum is not fastened by any neck, the columellar

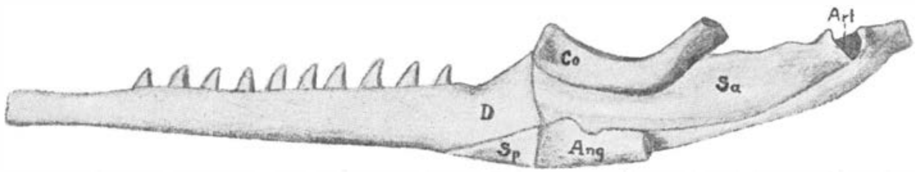

Fig. 6. *Clidastes Sternbergii.* Left mandible seen from outside. Red. to 1/3.

canal will lie within the lower half of the quadratum. The inner side of the bone is not accessible. I am not aware of any similar quadratum, but it is difficult to decide what is primary and what is due to later deformation

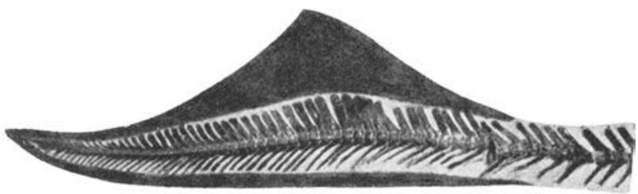

Fig. 7. *Clidastes Sternbergii.* Reconstruction of the caudal fin.

and this holds good not only in regard to this species, but still more in the case of others of which I have no material.

The mandible, which is visible only from the outside, corresponds in the main to that of other *Clidastes* species. The coronoideum is not especially high, but rather elongated. There is no suture discernible obliquely across the articular surface, possibly it is only this articular surface that represents the articulare. If so, then the entire bone all the way from the spleniale to the hindmost tip of the mandible would be the angulare. The reason why the boundary between the spleniale and the dentale cannot be fixed is to be found in the state of preservation. I cannot determine if the teeth are correctly restored.

Between the parietale and the axis, easily recognized by its large neural spine, lie five loose bones, which must belong to the atlas and possibly existing elements of a proatlas. The number of pieces, however, corresponds to the number necessary for the formation of an atlas.

Then follow the axis and five more cervical vertebrae. The position of the vertebrae and the state of preservation is not suited to give any information as to the conditions of the zygosphen and the zygantrum.

Then follow continuously 24 pectoral vertebrae, of which the last one does not seem to have supported any rib; however, this cannot be positively decided. Then comes an interval in which lie 10 loose and scattered

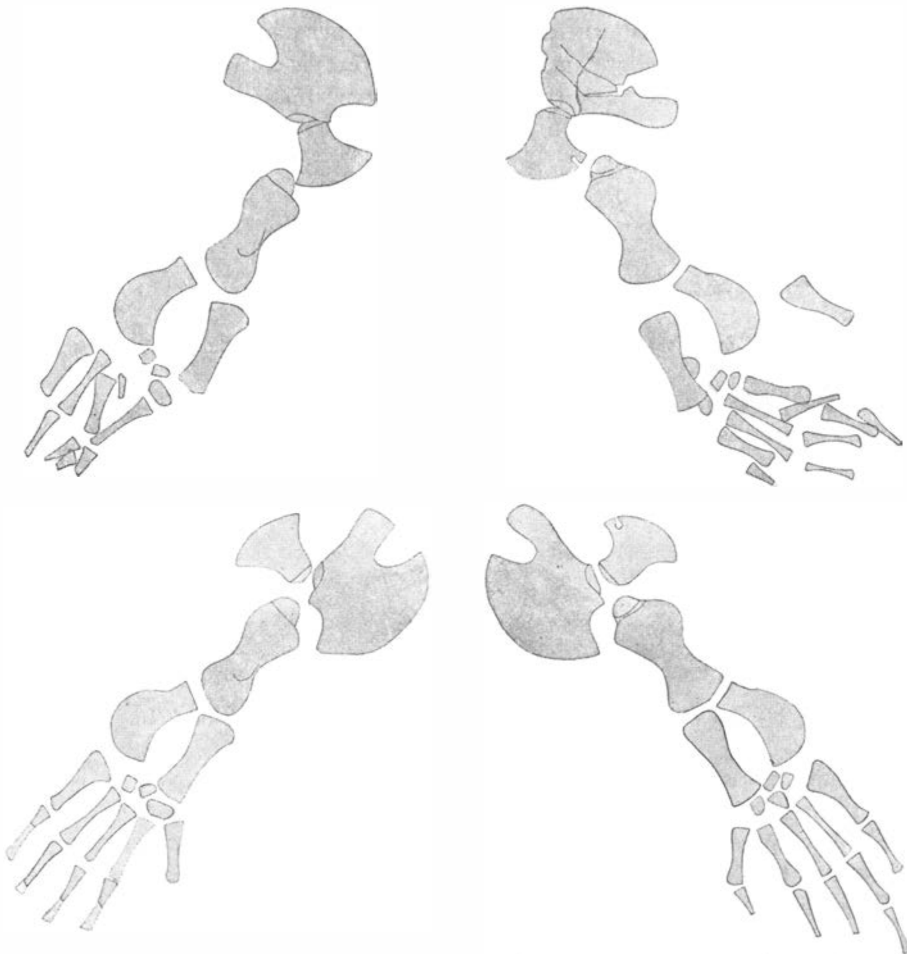

Fig. 8. *Clidastes Sternbergii.* Shoulder-girdle and anterior extremities. Above, in the position on the slab. Below, with bones arranged. Red. to 30 %.

vertebrae. The interspace has room for only 8 vertebrae. Of these 10, 4 are provided with processus transversi, and of these I consider the one that lies between the ilium and the femur to be the sacral vertebra and the remaining 3 to be the pygal vertebrae. The number is somewhat less than has previously been observed, and it is, of course, not excluded that one or two pygal vertebrae have disappeared. All the remaining 6 loose vertebrae have chevrons and belong to the tail. Next come 63 caudal vertebrae of which the first is somewhat loosened from its connection, the 11th is displaced, and the last three are somewhat out of place. Their shape indicates that some more small vertebrae must have existed.

Thus the species in question has had 104 vertebrae, of which 7 are cervical vertebrae, 24 pectoral vertebrae, 1 sacral vertebra, 3 pygal vertebrae, and more than 69 caudal vertebrae. The haemal spines are all, without articulation, connected with the vertebrae corpus, which is the chief reason for my having classed the species with the genus *Clidastes*.

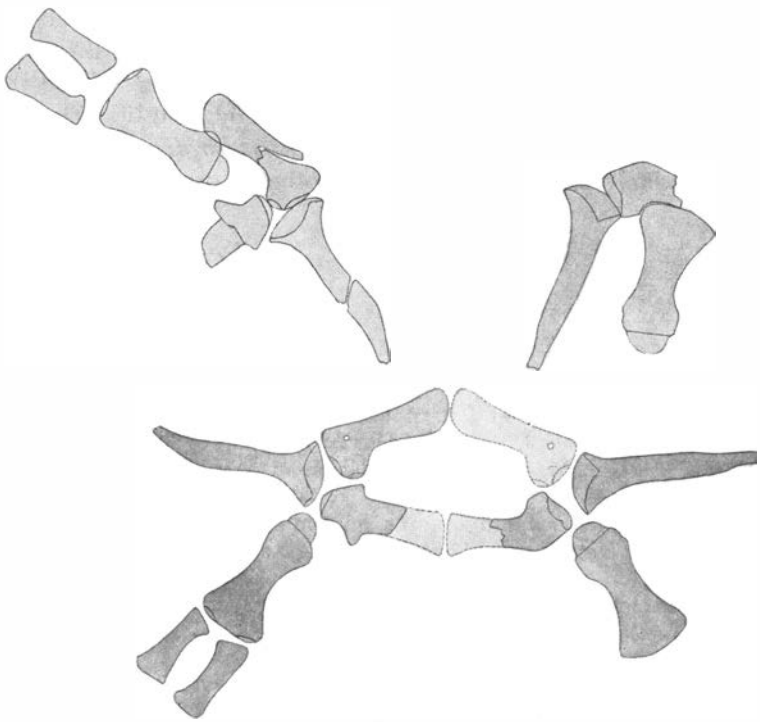

Fig. 9. *Clidastes Sternbergii.* Pelvic girdle and posterior extremities. Above, in its position on the slab. Below, with bones arranged. Red. to 30 %.

At the point where the neural spines are highest, the tail begins to turn a little downward. As the connection between the vertebral centra is quite undisturbed here, I have taken this curve into consideration and propose the accompanying reconstruction of the caudal fin.

Ribs are preserved on the 3rd to the 21st pectoral vertebrae. The 22nd and 23rd also seem to have had ribs.

The shape of the girdle and the extremities may be seen from the figures.

The coracoid is emarginate, and it is a small anomaly that such is the case also with the right scapula, but not with the left one.

The pelvic girdle does not present anything worthy of notice.

The extremities are less altered than in any known Mosasaurian. This is obviously indicated by the fact that on both the humerus and the femur a well developed ossified caput still remains.

Otherwise the primitive condition of the extremities is shown by the fact, that the elements, although flat, are nevertheless still so narrow, even more narrow than in *Tylosaurus*. This is less conspicuous in the front paddle because radius, as it is constructed after the *Clidastes*-type, thus becomes rather broad. In the hind paddle the difference, on the contrary, is more obvious.

In order to demonstrate, in this respect, the place of the species in question in the evolution series, I have on Pl. IV arranged the paddles in a series of Platynota and Mosasaurian extremities, where I have reduced the figures included to the same length of the radius and tibia respectively. From this plate it is evident that *Clidastes Sternbergii* in this respect has advanced less in transformation than any other Mosasaurian.

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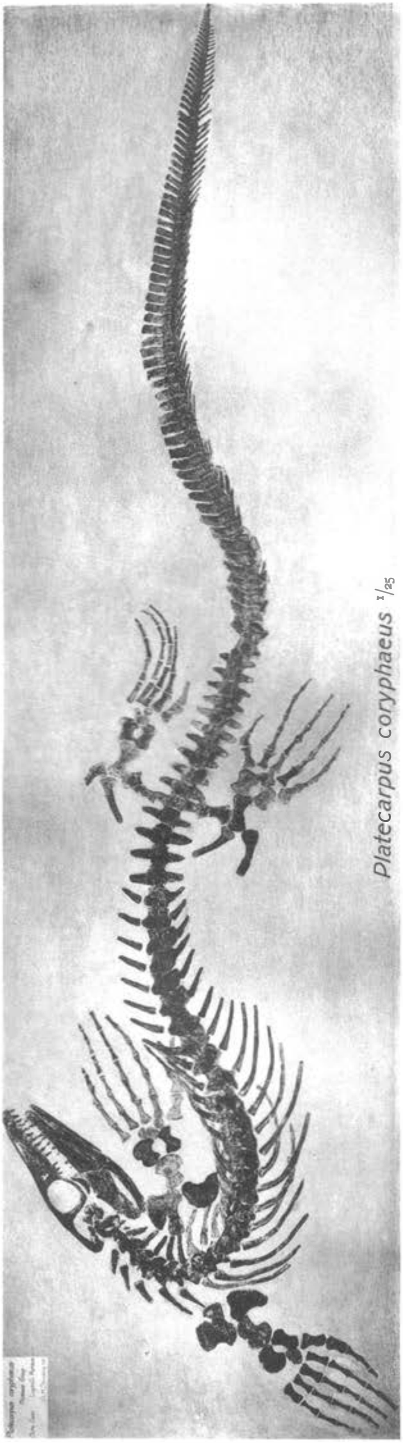
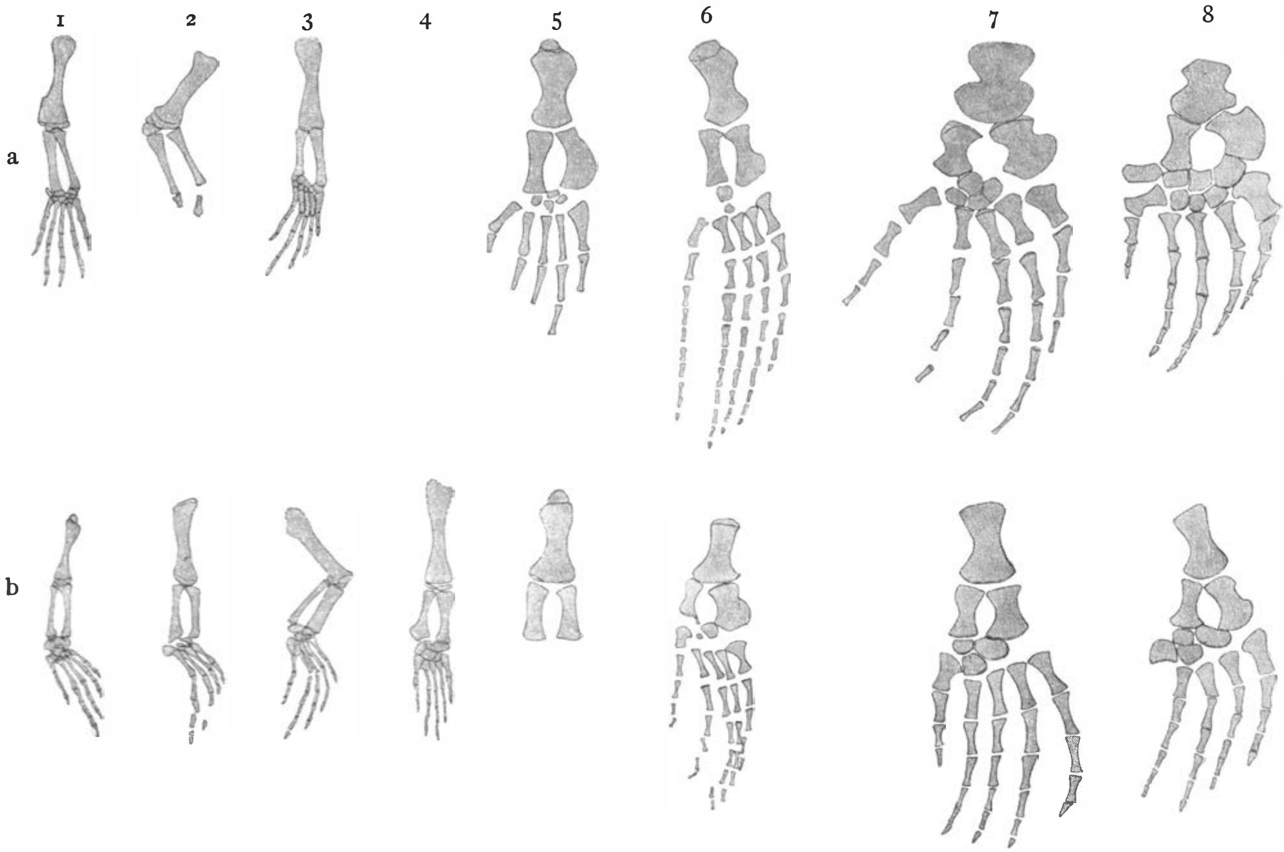


Platecarpus coryphaeus 1/25

Clidastes Sternbergii 1/13



In all the figures the radius and tibia respectively lie to the right. a = frontlimb, b = hindlimb.

1 a. Varan.
2 a. *Aigialosaurus dalmaticus* KRAMB. (After KRAMBERGER 6. Taf. 3. Fig. 1.)
3 a. *Opetiosaurus Bucchichi* KORNH. (After KORNHUBER 5. Taf. 2.)
4 a. Unknown.
5 a. *Clidastes Sternbergii* WN.
6 a. *Tylosaurus dyspelor* COPE. (After OSBORN 7. Pl. 23.)
7 a. *Platecarpus ictericus* COPE. (After WILLISTON 9. Pl. 44.)
8 a. *Clidastes velox* MARSH. (After WILLISTON 9. Pl. 23.)

1 b. Varan (after KORNHUBER 4. Taf. 21 Fig. H.)
2 b. D:o.
3 b. D:o.
4 b. *Hydrosaurus lesinensis* KORNH. (After KORNHUBER 4. Taf. 21. Fig. a.)
5 b. D:o.
6 b. D:o (after OSBORN 7. P. 185. Textfig. 12.)
7 b. *Platecarpus coryphœus* COPE. (After WILLISTON 9. Pl. 72. Fig. 2.)
8 b. D:o (after WILLISTON 9. Pl. 34 and 72. Fig. 1.)