On two new specimens of *Pachypleurosaurus* (Reptilia: Nothosauria)

NIALL J. MATEER

Mateer, N. J. 1976 02 01: On two new specimens of *Pachypleurosaurus*. *Bulletin of the Geological Institutions of the University of Uppsala,* N. S., Vol. 6, pp. 107—123. Uppsala. ISSN 0302-2749.

Two well preserved specimens of *Pachypleurosaurus* are described. One has only the post-cranial skeleton remaining, and the other has the post-sacral region missing. The two specimens thus serve as a composite for the whole animal. Parts that are common are so similar that they can be regarded as being the same species; however, it is the skull that is the critical area for a specific determination. The existing skull indicates a strong similarity to *P. staubi* Kuhn-Schnyder, but differences do occur to make this tentative. Clarification may occur in a forthcoming revision of the taxonomy of this genus.

Niall J. Mateer, Paleontologiska Institutionen, Uppsala Universitet, Box 558, S-751 22 Uppsala, Sweden, 10th August, 1975.

Introduction

Quite recently, two exceptionally well preserved specimens of *Pachypleurosaurus* were found in the vertebrate collections of the Palæontological Museum, Uppsala, which have not previously been described in the literature (Pl. I, IV). Both specimens were collected from the classic locality in the Vallone Caves near Lake Lugano, N. Italy, in 1932. Stratigraphically, they come from the Calcaire di Meride of the Middle Triassic; the sediment is a somewhat calcareous shale, most probably of a nearshore marine environment.

Previous work on this genus has been published by Peyer (1932), Zangerl (1933), and Kuhn-Schnyder (1959, 1963). From the figured specimens of Peyer and Zangerl, it would appear that the Uppsala specimens show a great deal of detail owing to preparation which has been most thorough even though the specimens are still embedded within the matrix.

Specimen R. 441 is complete anterior to the sacral vertebrae region; specimen R. 442 is, for the most part complete posterior to the pectoral region. As will be discussed later, there is no reason to suppose that these two specimens are from different species, thus a complete example is represented between the two specimens. The systematics of this genus are far from being settled. Both Peyer and Zagerl erected only one species for this genus: *P. edwardsi.* Kuhn-Schnyder (1959), however, raised a second species, *P. staubi*, mentioning at the same time that sufficient variability existed in the substantial collections obtained subsequent to Peyer and Zagerl to warrant even further specific groups. Kuhn-Schnyder (1963) made a distinction between these two species mainly on the basis of the bone arrangement on the snout: some examples have the premaxilla reaching back to meet the nasals, while the other specimens do not. This appears to be a real difference; however, a further analysis using more characters would perhaps substantiate this finding, and perhaps other structures in the pattern of variability may be found. However, it is not the purpose of the paper to discuss the taxonomy of this group which will be undertaken by Kuhn-Schnyder in the future.

Systematics

Order SAUROPTERYGIA
Suborder NOTHOSAURIA
Family PACHYPLEUROSAURIDAE
Genus PACHYPLEUROSAURUS Cornalia 1854
P. cf. *staubi* Kuhn-Schnyder 1959

Specimen R. 441

The skull (Fig. 1; Pl. II figs. 1, 2 & 3)

This has collapsed during preservation, but fortunately much of the fracturing has followed the

cranial bone sutures. Hence many of these bones are complete and are clearly defined. The ventral surface of the skull, however, is not clearly seen except for the upper side of the mandibles. The foramina are reasonably well preserved, although the posterior part of the skull has been crushed, and the pineal opening is obscured. The occipital region is also poorly preserved. Deformation on the right posterior side has been such as to give the impression of a deep recess of the squamosal. Although this does occur to a certain extent, there is considerable exaggeration in this case; the left side reveals the truer structure.

Premaxillae. — These are well preserved but are parted from each other medianly. They are, otherwise, complete; the length of the left premaxilla is 1,0 cm. These bones typically form the inner side of the nasal foramen and fuse with the nasals medianly. The character of this fusion is a point that has been taken up by Kuhn-Schnyder (1963) and will be treated in the discussion. Anterior to the nasal foramen, the premaxillae occupy the total surface of the snout. The border of the premaxillae and the maxillae occurs slightly posterior to the anteriormost part of the nasal foramen on the outer side. The line of this boundary can be seen on the left side to run posteriorly (Fig. 1). This is not the case of *P. edwardsi* as figured by Peyer (1932), Zangerl (1935), von Huene (1956) and Kuhn-Schnyder (1963). In these works, the outer boundary between the premaxillae and the maxillae runs anteriorly. Near to the anterior extremity of the premaxillae on the right side, a small foramen can be seen; this would appear to be for the accommodation of the olfacto-cortaco nerve. The anterior part of the nasal foramen is not uniformly rounded, but has a slight undulation in outline.

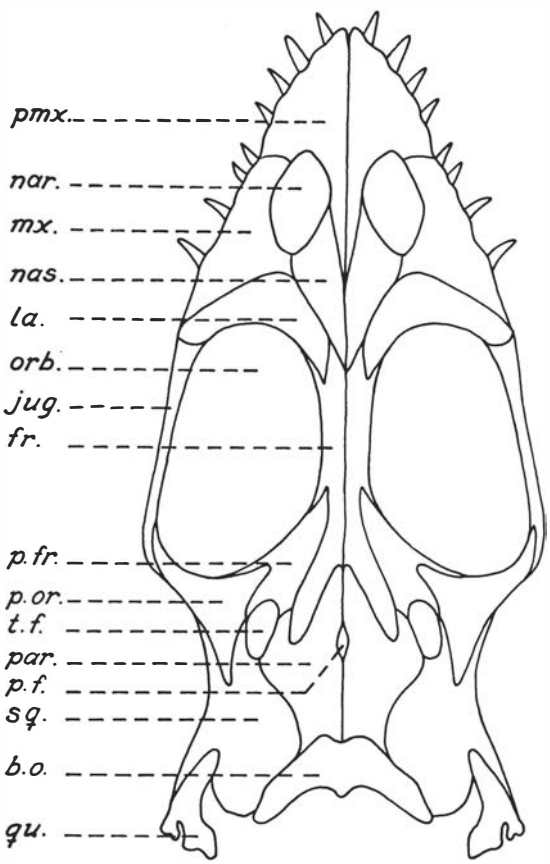

Fig. 1. A reconstruction of the dorsal surface of the skull (R. 441) × 3,0.

Maxillae. — These are not well preserved although the right side is defined much better. The maxillae pass from the premaxillae back to the jugals which border the orbital foramen. Ten teeth can be seen on the right maxillae; the total length of this bone being 0,87 cm. The form of the maxillae is that of a tooth-procuring bar with a triangular projection lying on the inner side. The anterior part of this plate forms the posterior border of the nasal foramen, and the innermost part meets the nasal medianly.

Nasals. — Only the right nasal can be fully seen. This bone is 0,6 cm long. It forms the posterior half of the inner border of the nasal foramen, and runs to the frontals. The full length of the bone lies on the inner side: the shape being somewhat triangular. The right side of this bone adjoins the maxillae along a short border. A longer and more posterior border lies with the lachrymal. Most of the left nasal may be seen, except for the anteriormost part which is obscured by the posterior projection of the premaxilla. On both the left and right nasals, the lateral projections have fractured along the base; that is, away from the main bar of the nasal. This rather suggests that there was a slight furrow along the median line of the skull during life, with the nasals rising up on either side. Thus, during compression, fracturing occurred along the weak point.

Lachrymals. — These large and well formed bones mask the anterior border to the orbital foramen. In both the left and right lachrymals, the median border with the frontals can be seen. However, the lateral border with the jugals is not seen, again due to the effects of compression presumably because of the somewhat elated situation of the orbit during life. The shape of the bone is rather scapula-like in that there is a main ridge

on the inner part of the bone, which laterally broadens out into a narrow spade-like structure. The arc of this broad plate adjoins the nasals, maxillae and jugals. The straight length of the lachrymal is 0,53 cm (from the jugal to the frontal).

Frontals. — The anterior part of the frontals is not clearly defined, due mainly to the obscuring lachrymals. The best preserved frontal, on the left, has an estimated length of 0,95 cm. As with many other parts of the skull, deformation has misplaced some bones, thus on the right frontal, a groove is seen on the frontal into which the post-frontal once slotted. This groove is long and slender, and secondary furrows can be seen within the main groove. The general shape of the bone is that of a gently curving flattened bar with a slight taper posteriorly. The continued lateral curve of the posterior part of the frontal is not indicated by Peyer (1932), Zangerl (1935 or v. Huene (1956). If anything, they suggest a slight reversal of the curvature at the extreme posterior part of the bone. Also, there appears to be little evidence of a median connecting plate between the two bifurcated prongs of the frontals at their posterior end. However, these two differences with the literature might possibly be due to compressional effects. As with other bones of the skull, there is no surficial patterning.

Jugals. — These are not so well preserved. The anterior borders are very shattered and indistinct. Both are separated from the post-orbital posteriorly. The main part of this bone is a blade-like shaft gently curving inwards at each end. The inner facet of the posteriormost end of the right jugal, where the articulation with the post-orbital occurs, exposes a sligthly furrowed surface. These furrows are short and are three in number and lie within an oval facet, which lies higher than the remainder of the jugal on the left side, thus exposing the inner surface. The length of the jugal is estimated to be 1,0 cm.

Post-frontals. — This bone is clearly defined and forms an inner arc of the orbital foramen running from the jugal to the post-orbital. It also acts as the anterior border for the temporal foramen. There is a deep notch into which the post-orbital slots. This cleft is, in fact, rather rounded with a certain irregularity of pattern on the posterior side. Thus a part of the post-frontal is definitely seen to lie anterior to this cleft, in contrast to published reconstructions (op. cit.) which do not. Again, it is not inconceivable that this is due to different states of preservation.

Post-orbitals. — These are somewhat irregularly triradite: a wedge-shaped process fitting into the above mentioned cleft in the post-frontal, a bar directed laterally to adjoin the jugal, and a deep "V" shaped process running posteriorly into the squamosal (Fig. 2). The facet for attachment to the jugal (and vica versa on the jugal) lies in an opposite relationship to that figured by Zangerl (1935); the jugals fit on the posterior surface of the post-orbital. A larger part of this bone lies in the deep projection is atypical of published reconstructions of *P. edwardsi.*

Squamosals. — The left and right bones of this specimen are preserved in different ways such that it is difficult to determine the original form of this bone. One area that is quite the same however, is the anterior border with the post-orbital (see above). This boundary is shown in Fig. 2. The left squamosal is quite straight. The right squamosal, on the other hand, shows a quite different form (Fig. 1; Pl. II fig. 1). There is a sharp concavity in the outer surface in contrast to the near straight surface of the left squamosal. The inner surface

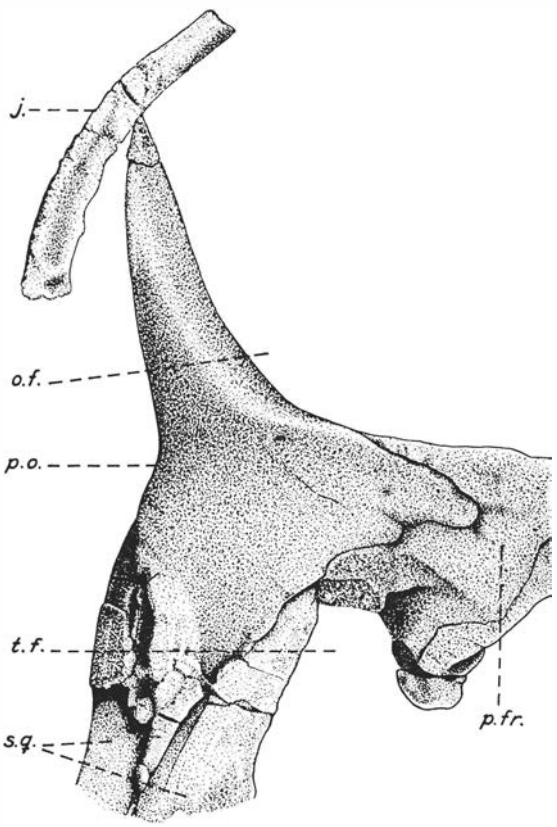

Fig. 2. The left post-orbital (R. 441) × 13,0.

is considerably expanded; this is not present on the left side, thus is probably broken. The longitudinal axis of the left side is more or less posterior-anterior; that of the right side is considerably curved inwards. Here, a great part of the bone obscures the underlying parietal. Because of the missing inner protruberance and the absence of a concavity on the left squamosal, a much greater part of the parietal can be seen. In both cases, the posterior part of the bone has parted slightly from the main body of the bone. Laterally on the external side of the bone, a projection forms the anterior articulation with the quadrate. The precise length of this projection is difficult to estimate, but it appears to run almost to the quadrate-mandible articulation (Pl. II fig. 3) Neither this projection of the squamosal nor the quadrate are present on the left side.

Parietals. — Owing to the collapsed nature of the preservation, the parietals lie beneath the squamosals, which are largely obscuring (see above). The anterior end of the parietals is exposed however, but these are somewhat fractured at this point. Anterior projections run between the two parietals posteriorly diverging frontals. The median boundary between the two parietals is poorly preserved. The lateral edges are obscured. The posterior edge of these bones are exposed medianly. From the posterior border of the parietals, this edge runs away at a slight posterior angle after a minor concavity either side of the small median posterior projection. The suggested relationship between the parietals and the squamosals is shown in the reconstruction of the skull (Fig. 1).

The mandibles (Pl. II fig. 1)

Because this specimen is exposed dorsally, the ventral side of the skull is poorly revealed. This is true of the mandibles also. There has been a slight lateral displacement between the cranium and jaws, thus some of the latter is visible, mainly on the right side. The right dentary shows large tooth sockets; there are an estimated 24 sockets, many with teeth present. The dentary has parted from the surangular by a short lateral displacement; the nature of the attachment is thus clearly exposed. The angular may be seen beneath the surangular on the inner side. Right and posteriorly, it is clearly exposed dorsally showing the jaw articulation socket very clearly. Behind this socket, the articular projects some way back. The articular-surangular socket can be followed forwards along the outer side of the jaw.

The surangular has a high dorsal ridge with a deep furrow running either side. Compression effects have distorted the original form rather badly. The articulation sockets face inwards slightly and are occupied by the quadrate. Immediately behind the articulation socket, there is a collapsed remnant of a notch.

The left mandible is poorly exposed, thus little more can be said. The articular is partly visible lying on its side.

Teeth. — Unfortunately, not many teeth are preserved, but those that are lie in the anterior part of the skull and jaw, and clearly show a strong pattern (Pl. II fig. 2). The outer surface is quite smooth, broad and flattened; there is a slight elongated depression running distally along the surface of the tooth. At the edge of this upper surface, the side falls away at a sharp angle: this side surface is heavily grooved. The fine (second tooth of the right premaxilla) grooves run parallel to each other, but not parallel to the curvature of the tooth, such that there is a slight discordance at the distal end of the groove with the upper surface of the tooth. The teeth are quite strongly curved inwards; it is difficult to postulate the function of these inwards curving teeth, but it may be related to the phenomena seen in the modern squamata. This group often has a somewhat flexible skull about a posterior-anterior axis to accommodate prey. The rebound from this elasticity causes the teeth to point inwards slightly to facilitate gripping. Inward curving teeth may be of further use in such a mode of feeding.

The upper right jaw indicates that the tooth replacement is by alternation. Considerably larger and well formed teeth are intersperced by smaller and less well formed teeth.

The limbs and girdles

The pectoral girdle is not in its original configuration, and only the scapuli and fragments of the clavicles are visible. Only the femur is present in the pelvic limb.

Scapulae. — Most of the left and right of the bone is well exposed, although the distal, humerus articular, ends are missing (Fig. 3). The main blade in each case is well preserved showing a pronounced surface relief. Part of the blade that fuses with the clavicle is missing. There are a series of shallow grooves running parallel with the main shaft of the scapula, which fades out into a fine pitted pattern where the main shaft broadens into the blade. At the base of this blade, there is a band around the top of the main shaft which has a pronounced dendritic groove pattern which

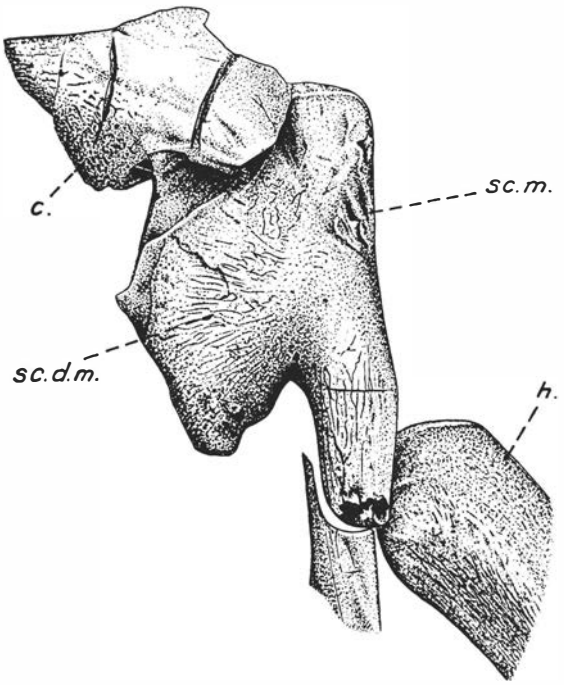

Fig. 3. The right scapula (R. 441) × 6,0.

indicates the attachment of the scapular deltoid muscle. This does not extend to the periphery of the blade. The shape of the scapula is typically asymmetrical with most of the blade lying to one side. On the opposite side, there is a restricted area with heavy pitting in a small depression. This is probably the attachment scar of the supracoracoidal scapularis muscle. These features are distributed on both the left and right scapuli. The greatest width of the scapula, at the base of the blade, is 0,59 cm; the length is not complete.

Clavicles. — Only part of the left and right of these bones are exposed; they are also somewhat cracked. The region of fusion with the scapula is partly missing, and is devoid of any surface pattern. More proximally however, there is a marked area of semi-dentritic grooves and pits. Again, this is presumably the attachment scar for the median pectoral muscle. The remainder of the clavicles and interclavicles lie beneath the vertebrae and ribs.

Humeri. — Both the left and right humeri are exceptionally well preserved, showing the structure and surface patterns clearly (Fig. 4; Pl. III fig. 1). Most of the muscle attachment scars may be seen at either end of the bones. The epicondylar foramen is clearly visible; there is no actual foramen present, only a deep notch. On the epicondyle, and by epicondylar notch, there is a deep, but narrow

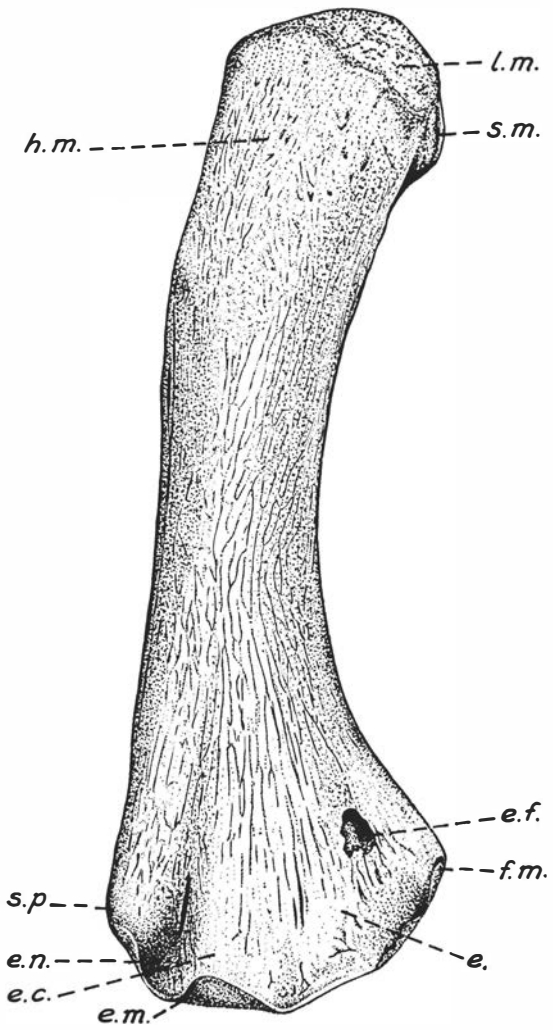

Fig. 4. The left humerus (R. 441) × 7,2.

furrow following the trend of the longitudinal surface pattern; here the furrows transform into pits. The epicondyle may be traced proximally to the median head for the attachment of the triceps. The adjoining scar of the humero-radialis muscle is clearly seen.

The general form of the humerus is rather typical: an expanded distal end containing these processes; this end is quite rounded. The inner side of the main shaft is curved, and the outer side is rather straight with a slight angular displacement distally at the humero-radialis muscle attachment scar. This longitudinal pattern becomes somewhat disoriented at the centre of the shaft with a slight lateral trend (Fig. 4). The left humerus is 1,77 cm, and the right is 1,75 cm long.

Ulnae. — These are also well preserved on both sides (Pl. III fig. 2), and appear quite similar in form. They expand considerably posteriorly and anteriorly. The proximal end is gently curved, fitting, in the case of the left ulna, closely into the facet of the humerus. The proximal half of the bone is rather featureless, while the distal end has two prominent condyles, one larger than the other. The major condyle forms a ridge bordering the outer side. This condyle has a relatively large facet for articulating with the intermedium of the carpus. The minor condyle rises imperceptably from a depression on the inner side at the extreme distal end. This smaller facet presumably articulated with the ulnare. At the centre of the shaft, on the left ulna, there is faint pitting which spreads radially in the form of small furrows, mainly on the inner side. This feature is restricted. The length of each bone is 0,83 cm.

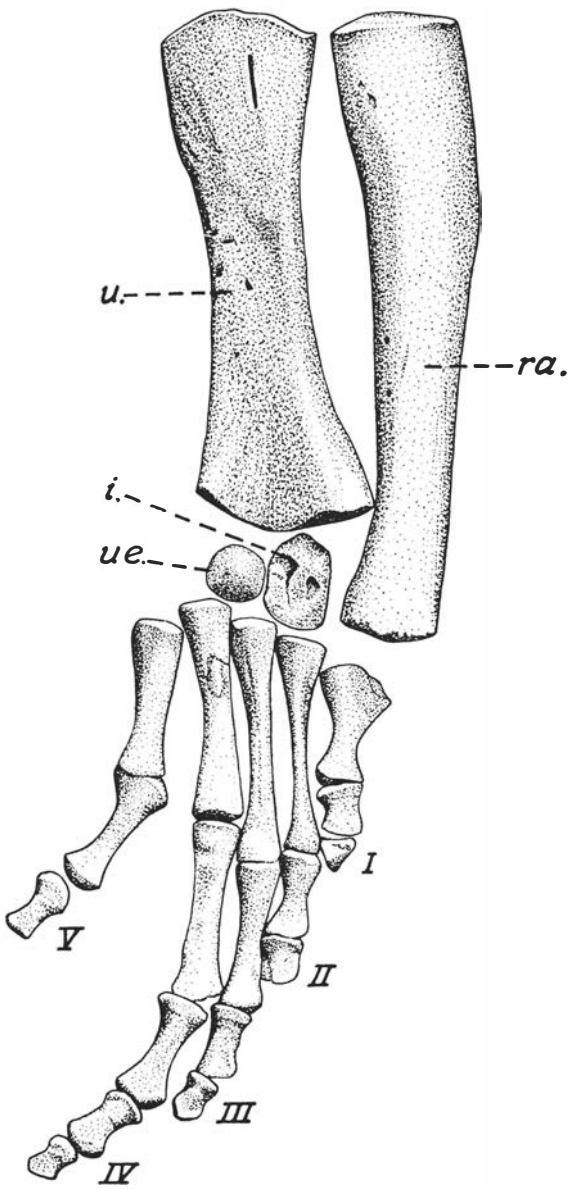

Fig. 5. The left radius, ulna and manus (R. 441) × 8,0.

Radii. — The left radius is 16 %, and the right radius is 11 % longer than their respective ulnae. Their lengths are 0,8 cm and 0,9 cm. This bone is not only longer than the ulna, but straighter and narrower (Fig. 5; Pl. III fig. 2). The broader proximal end articulates with the epicondylar facet of the humerus. The outer surface curves inwards approximately half way along the shaft, such that the distal end is much narrower. The distal facet articulates with the first digit, although there is a small gap between which there may have been a radiale. There is no evidence on either limb for this though. The left radius retains some of the dentritic furrowing so characteristic of the humerus, towards the distal end. Both radii contain two small (one twice the length of the distal) notches on the inner surface aligned longitudinally.

Carpi. — In both forelimbs, only the intermedium and ulnare are present. The intermedium, well preserved on both sides, has two heavily rounded ends with a very short shaft thus giving an almost elliptical shape. On the right side, these bones articulate directly with both the ulna and the second digit. The ulnare is quite rounded with a deep notch at one end. On the left side, the ulnare has space between it and the ulna on the one side, and the third and fourth digit on the other (Fig. 5, Pl. III fig. 2). There are no such gaps on the right side.

Digits. — Again these are well preserved and are largely complete. In each case, five digits are present. The phalangeal formula for the left manus is: 2—3—4—6—1 (Fig. 5; Pl. III fig. 2); and for the right manus: 3—3—4—5—3. The complete formula for this specimen is thus: 3—3—4—6—3. Terminal phalanges are present on the first digit of the right manus, and on the fourth digit of the left manus. The phalanges are quite typical: the first phalanges are long and slender with slight expansion at either end. Successive phalanges are shorter with more pronounced expanded ends; the terminal phalange is quite round. The first phalange of the first digit however, has a large expanded proximal surface and a smaller than normal distal end.

Femora. — The right femur only is present, but this is well preserved. The anterior surface only is presented, which unfortunately, shows only a few of the characters of this bone. Both ends appear quite flat with little indication of articular activity with the pelvic girdle or the radius or ulna. The general form of the femur is one of being rather long and slender with a slight expansion at either end; the greatest expansion occurs on the dorsal distal surface. As with other limb bones of this specimen, there is a pronounced longitudinal pattern on the surface: at either end, the pattern is of long slender furrows, but in the centre of the shaft, the direction is less pronounced and more dentritic. Towards the articular surfaces, the furrows decline into a series of pits. The length of this femur is 1,65 cm.

The vertebral column (Pl. I)

Cervicals. — Eighteen cervicals are present and one is missing owing to the specimen being broken in two parts. They are completely preserved although somewhat compressed. The atlas and axis however, are not so clearly seen to the extent of being indescribable. From the first cervical back, the anterior and posterior zygapophyses, although distorted, are well preserved and all interlock appropriately. The neural spines are compressed into their neural arches, but are quite complete except for the crowns. The anterior cervicals have prominent posterior zygapophyses and deep facets by the anterior zygapophyses for their reception. The variation between the anterior and the posterior cervical vertebrae is gradual, the main change being in the proportion of the length and width: the latter becoming lesser than the former. There is tendency for the posterior zygapophyses to become still more prominent. Overall size also increases posteriorly.

Dorsals. — The difference between the dorsal and the cervical vertebrae is difficult to ascertain with only the restricted dorsal aspect exposed. Here the first dorsal is regarded, somewhat arbitrarily, as being that which the first large sized rib is attached. This occurs by the clavicle. Taking this to be so, there are 22 dorsal vertebrae. There is little or no variation between these; neural spines have again been compressed into the neural arches, and their crowns are missing. The posterior and anterior zygapophyses are well preserved but are not exactly in their original form: some posterior-anterior compression has occurred, thus dislocating the articulation somewhat. The angle of the zygapophysical facets is approximately 45°, thus they say little as to the mobility of the animals backbone as a unit during life. Diapophysial evidence is lacking, but there is some trace of transverse process on some vertebrae. These appear at the base of the anterior zygapophyses.

The sacral and caudal vertebrae are not present in this specimen.

Specimen R. 442 (Pl. IV)

This specimen is not so well preserved as specimen R. 441, nor is it so complete. However, the hind limbs are well preserved and something of the nature of the caudal vertebrae can be seen, thus complementing what is missing in the previously described specimen. Although the skull is missing in this specimen, it would appear to be the same species.

The limbs and girdles

Scapulae. — Only the left scapula is preserved and this, very well, although slightly cracked. (Pl. III fig. 3). The shape is quite identical with those described for specimen R. 441. The surficial patterning is clearly seen; this primarily occupies a central region on the blade, concentrated perhaps mostly nearer the posterior part of the blade on the inner side. Anteriorly, the patterning leads to the scar of the supracoracoidal scapularis muscle, which lies on the anterior outer edge of the bone.

Clavicles. — These can be identified, but are very badly exposed and preserved such that little of diagnostic value can be obtained.

Humeri. — Both the left and right humeri are extant although poorly preserved; the left is more complete than the right. The entepicondylar foramen is clearly seen in the left humerus, as is the ectepicondyle. Although the original surface of the shaft is missing in places, impressions of the longitudinal patterns are present. The character of the humero-radialis muscle attachment scar is quite similar to that on the right humerus of this specimen.

Ulnae. — The ulna is poorly preserved on the left side, and absent on the right. Of what can be seen, they appear identical with those of specimen R. 441.

Manus. — Some disarticulated members of the manus are present on the left side only.

Pelvic girdle. — This is mostly obscured by the sacral ribs and vertebrae (Pl. IV). However, the

peripheral edge of the ischium, and to a lesser extent the pubis, are seen (Pl. V fig. 2). There is a small piece missing from the periphery of the ischium which is otherwise quite rounded. The upper surface of the pubis is seen between the two sacral ribs and the proximal end of the femur. There is little or no surficial pattern on these bones. The articulation facets for the ischium and pubis are facing upwards and are thus clearly visible. The two facets are dorsally rounded and are quite separate, being connected ventrally. The ventral edge appears to be quite flat, as are the external sides of the facet. The depth of the posterior and anterior facets are 0,27 cm and 0,29 cm respectively; thus the anterior is rather larger than the posterior. The anterior facet faces slightly anterior, while the posterior facet faces slightly inward. The cleft dividing the facets dorsally can be seen to close along the shaft of the ilium. On the right side, only a fragment of the proximal part of the pubis is seen; the ischium is also visible. Little of the character of these bones can be determined.

Femora. — Both the right and the left femurs are clearly seen and are very well preserved. The ventral and dorsal surfaces are exposed, respectively. The left femur shows the full extent of the proximal end and part of the articular facet (Fig. 6; Pl. V fig. 2). In the centre of the broad head, the rugosity marking the attachment of the pubischio-femoralis muscle clearly marks the intertrochanter fossa. This fossa is triangular, with the ventral edge of the bone to the ventral edge of the proximal articular facet. To the dorsal side of the posterior ridge system, faint marks indicate the presence of another attachment of the pubischio-femoralis muscle. A lip of the proximal articular surface, at the dorsal end, projects to meet the ventral ridge system. From the head of the femur, this bone narrows considerably along

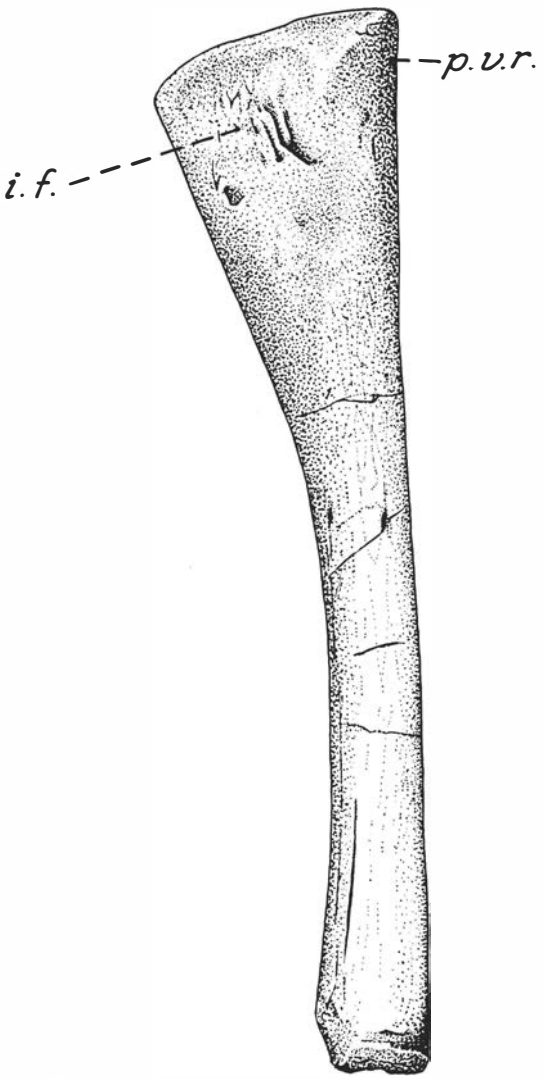

Fig. 6. The right femur (R. 442) × 8,8.

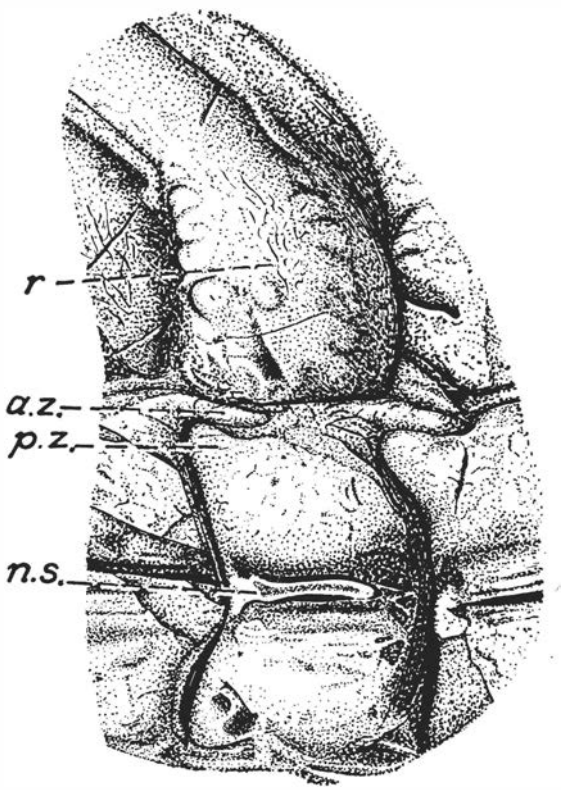

Fig. 7. The 19th dorsal vertebra (R. 442) × 11,0.

its shaft. The shaft shows the characteristic dendritic surface pattern only faintly. Midway along the shaft, two small foramina lie dorsally and ventrally. The articular angle of this femur that is exposed does not show both of the dorsal trochanters. The trochanter for articulation with the tibia is rather featureless and the facet is quite flat. The right femur shows a rather uniform dorsal aspect. There is a gentle indication of an attachment of the pubischio-femoralis internus muscle by a slight rugosity on the centre of the head. Again, there is also a faint surface patterning along the shaft. The distal end is very similar to that of the ventral/anterior aspect of the left femur, except that the fibula articulation is exposed. The distal facets of the femur thus appear quite flat and undifferentiated, suggesting little movement between the femur and the tibia and fibula.

Vertebral column (Pl. IV)

Dorsal vertebrae. — These are much the same as those described for R. 441. The neural spines have again collapsed into their respective neural arches. The posterior and anterior zygapophyses are all interlocking as in the life position. A few of the posteriormost cervical vertebrae can be seen, but are very poorly preserved. A typical dorsal vertebra (the 19th) is shown in Fig. 7.

Caudal vertebrae. — (Pl. V fig. 3) The sacral vertebrae are indistinguishable from the dorsal vertebrae; the dorsal type vertebrae run posterior to the sacral region with little or no change in structure, except for a perceptable decrease in size.

Posterior to the sacral region, the character of the dorsal vertebrae grade quickly to those of the caudal vertebrae. The preservation is a little different in the caudal vertebrae: they tend to lie on their side (except for the four anteriormost), thus something of the lateral view can be seen. In the sixth to the tenth vertebrae, the centra and neural spines and arches have become separated. On the latter, the posterior and anterior zygapophyses are well preserved in some cases, although the neural spine is generally missing. The spines are quite narrow and pointed where they are present. After the tenth caudal vertebra, the neural spines become very much reduced. The posterior and anterior zygapophyses gradually take a lower profile, but still remain articulated.

The centra also become reduced, more particularly in depth: the length varies very little. Thus running posteriorly, they tend to become rather elongated. The first ten centra are rather poorly preserved, although they show their articulation surfaces (? posterior). A characteristic feature of this surface is the cross pattern: a depressed band running dorso-ventrally with lateral depressions either side. After the tenth vertebra, the centra expose only a lateral view and are considerably crushed. Median constriction is relatively slight. Some 28 caudal vertebrae are present; approximately 5 to 10 are missing from the distal extremity.

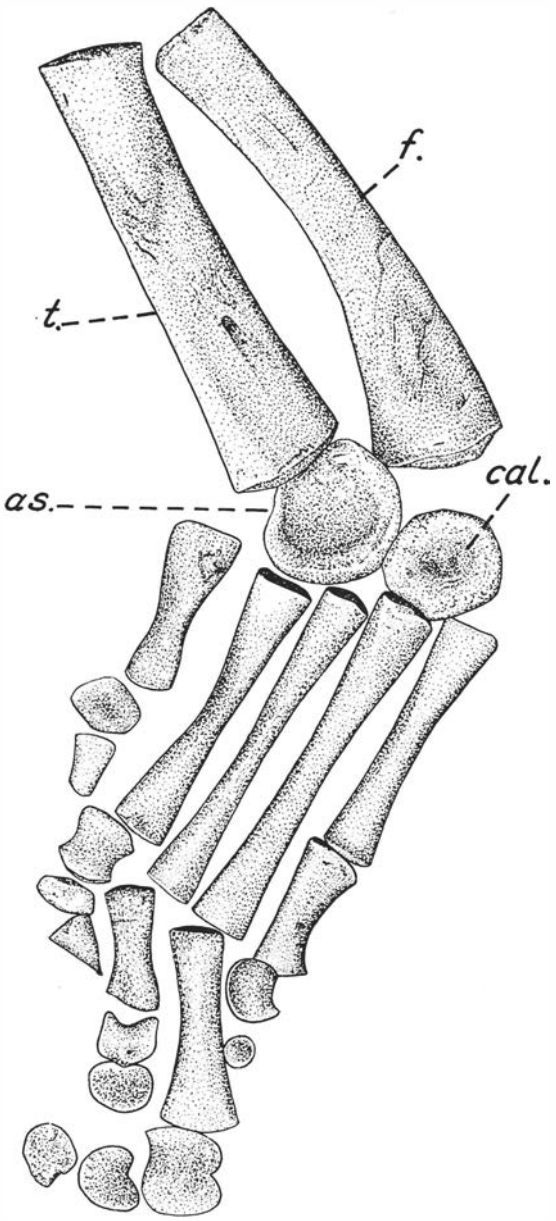

Fig. 8. The left fibula, tibia and pes (R. 442) × 8,0.

Ribs (R 441 and R. 442). — These first appear on the 18th vertebra, and the full sized ribs appear on the 21st vertebra (Pl. IV). From this point to the sacral vertebra, there is little variation in form or size. No special characters can be seen on the ribs except that they thicken considerably. Details of the dorsal rib heads and vertebrae are shown in Fig. 7. Cervical ribs are present (although not all are present); they are very small and project both posteriorly and anteriorly being adjoined to the transverse process centrally. A total of 25 ribs are present on the left and right sides between the pelvic and pectoral girdles.

Tibiae. — The left tibia is well preserved but is rather a featureless bone (Fig. 8; Pl. V fig. 1). The proximal surface is only faintly convex where it articulates with the femur. At both ends, there is a sharp ridge bordering the articular surface with the shaft per se. The main shaft is quite stout and there is little expansion at either end. There is no surficial patterning as on other proximal limb bones. The length of the left tibia is 0,8 cm. The right tibia is also well preserved but is unfortunately partly obscured by the proximal end of the fibula. Little further can be said as to the character of this bone except that there is a slight ridge on the dorsal surface. This runs only a short way on the outer side at the proximal end; compression has obscured this inner feature on the left tibia. The length of the right tibia is 0,9 cm.

Fibulae. — On the left and right, the fibula is both longer and more strongly curved than the tibia. Preservation is excellent in both cases (Fig. 8; Pl. V fig. 1). The proximal end is quite narrow, and like the tibia it has a near flat articulation surface. The inner side of the shaft is gently curved while the outer side is more strongly curved, especially distally. The distal articulation surface, although slightly broader, is much the same as that of the tibia.

Astragali. — These are well preserved and complete, and are situated between the tibia and the first and second digits (Pl. V fig. 1). On the left side, this bone is near circular with a slight irregularity on the articulation surface for the tibia (Fig. 8). On the right side, there is a clear flattening of the proximal end for articulation with the tibia. There is a gentle depression at the centre of the bone, which may have been enhanced by compression. The diameter of the astragalus is 0,6 cm.

Calcanea. — These are also completely preserved, and lie on the inner side of the astragulus on each side, between the fibula and the third and fourth digits (Fig. 8; Pl. V fig. 1). Again this bone is near circular on both sides, but less so on the right side; there are no distinguishing features present. There is a slight depression at the centre, thus giving the appearence of a red blood cell.

Digits. — On the whole, these are mostly present. The phalangeal formula is: 3—2—3—3—3 for the right side, and 4—5—4—4—3 for the left side. On the left side, terminal phalanges are present on all digits (Fig. 8; Pl. V fig. 1). The first phalanges are typically very long and slender, and are expanded at each end, although less so on the first digit. The second phalanges are also quite long, but not so much as the first phalange. These second phalanges of the first and second digits are quite different, being much stouter and thus more circular. Subsequent phalanges are as long as they are broad, and mostly have a small concavity (of variable form) on the proximal articulation surface. Extreme phalanges have rounded distal ends.

Acknowledgements. — I should like to thank Mrs. Dagmar Engström for preparing the text-figures, and Mr. G. Andersson for the photographs.

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Appendix:

List of a abbreviations used in the figures

as.	astragalus
a.z.	anterior zygapophysis
b.o.	basioccipital
c.	clavicle
cal.	calcaneum
e.	epicondyle
e.c.	ectepicondyle
e.f.	epicondylar foramen

e.m. extensor muscle attachment
e.n. epicondylar notch
f. femur
f.m. flexor muscle attachment
fr. frontal
h. humerus
h.m. humero-radialis muscle scar
i. intermedium
i.f. intertrochanter fossa
j. jugal
la. lachrymal
l.m. latissimus-dorsi muscle scar
mx. maxilla
nar. narial
nas. nasal
n.s. neural spine
p.f. parietal foramen
p.fr. post-frontal
pmx. premaxilla
p.or. post-orbital
p.v.r. proximal ventral ridge
p.z. posterior zygapophysis
qu. quadrate
r. rib
ra. radius
sc.d.m. scapular deltoid muscle scar
sc.m. scapulo-humeralis anterior muscle scar
s.p. supinator process
sq. squamosal
sur. surangular
t. tibia
t.f. temporal foramen
u. ulna
ue. ulnare

Printed by Ekenäs Tryckeri Ab, Ekenäs, Finland February, 1976.

Explanation of plates

Plate I

Pachypleurosaurus cf. *staubi.* Specimen R. 441. × 1,2.

Plate II

Fig. 1. *P.* cf. *staubi.* Specimen R. 441. Skull. × 3,25.
Fig. 2. *P.* cf. *staubi.* Specimen R. 441. Anterior teeth of the left premaxilla. × 13,5.
Fig. 3. *P.* cf. *staubi.* Specimen R. 441. Articulation socket between the surangular (s.) and quadrate (q.) with the angular. × 13,0.

Plate III

Fig. 1. *P.* cf. *staubi.* Specimen R. 441. Left humerus. × 8,0.
Fig. 2. *P.* cf. *staubi.* Specimen R. 441. Left manus, ulna and radius ×. 7,5.
Fig. 3. *P.* cf. *staubi.* Specimen R. 442. Left scapula. × 8,0.

Plate IV

Pachypleurosaurus cf. *staubi.* Specimen R. 442. × 1,2.

Plate V

Fig. 1. *P.* cf. *staubi.* Specimen R. 442. Left pes. × 8,0.
Fig. 2. *P.* cf. *staubi.* Specimen R. 442. Left femur and ilium. × 9,6.
Fig. 3. *P.* cf. *staubi.* Specimen R. 442. Sacral and caudal vertebrae. × 6,5.

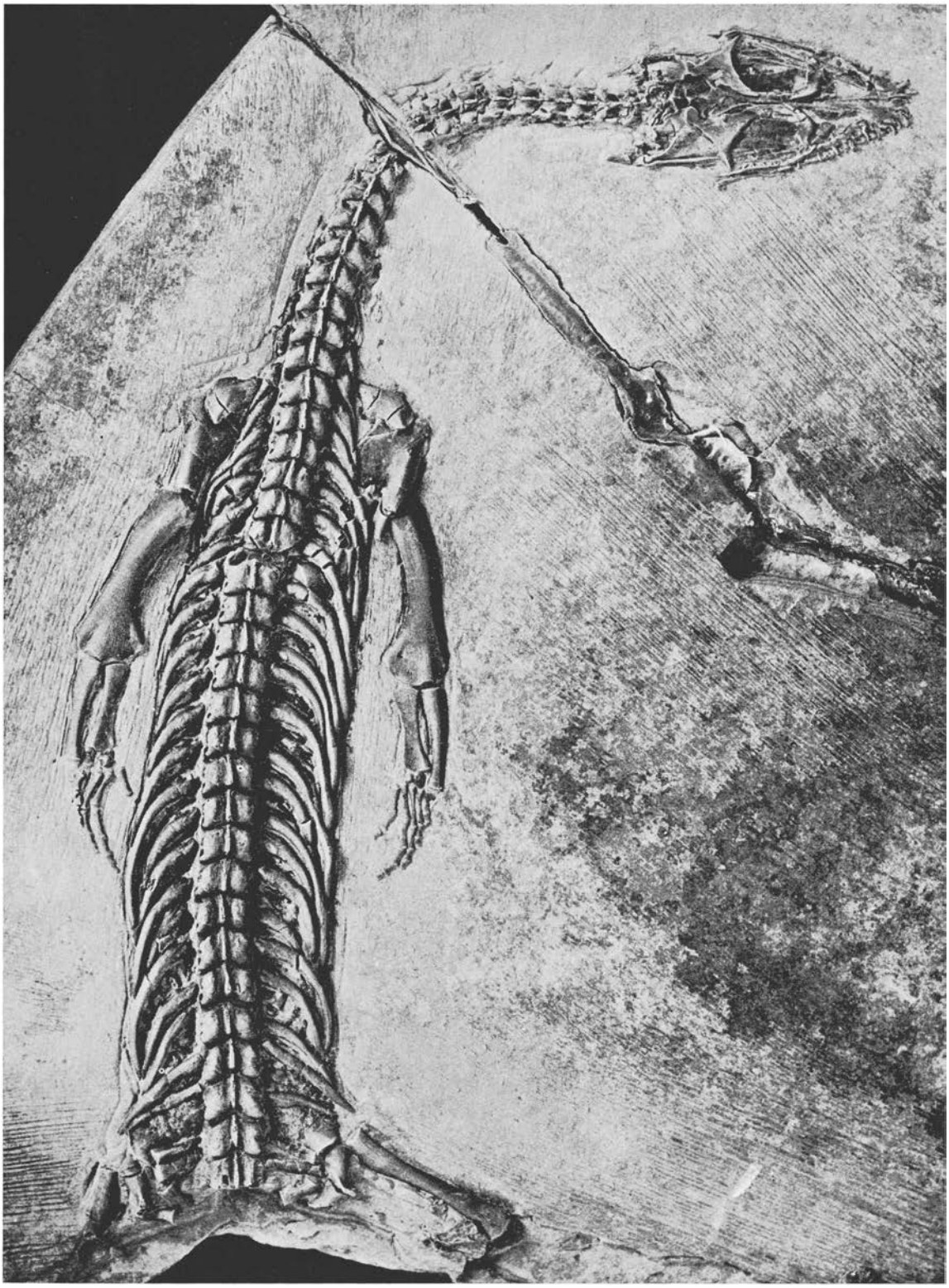
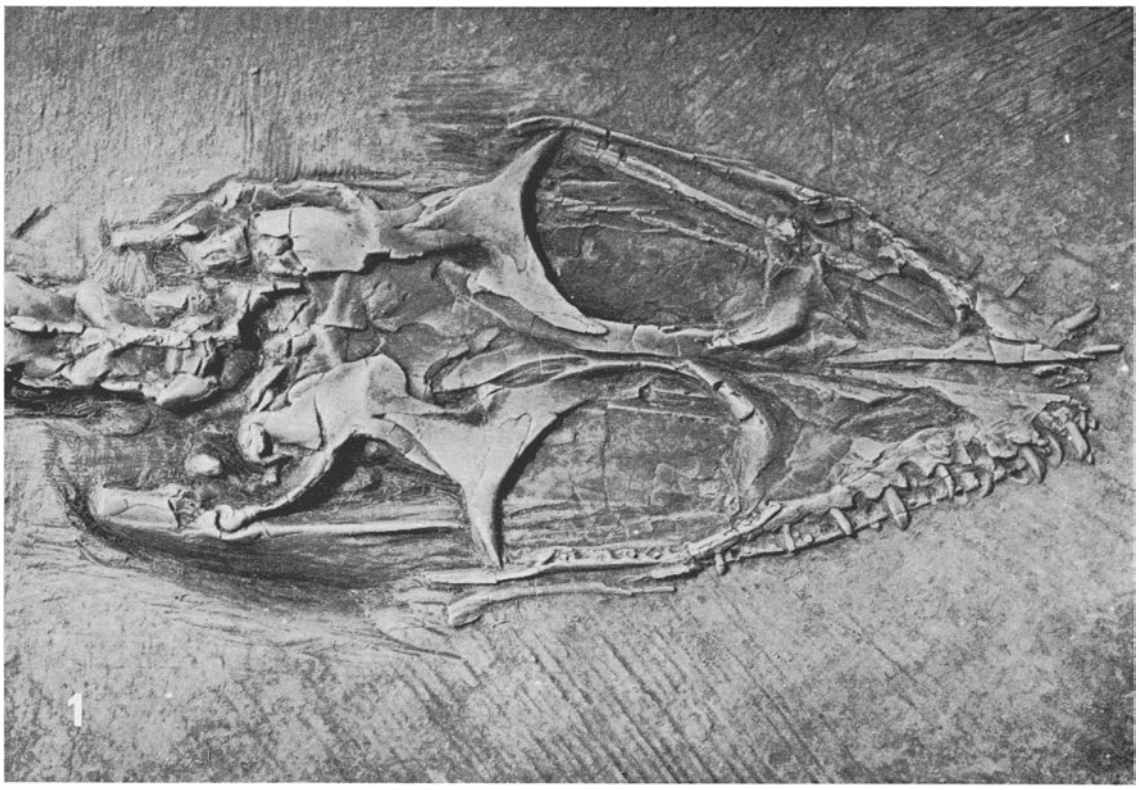
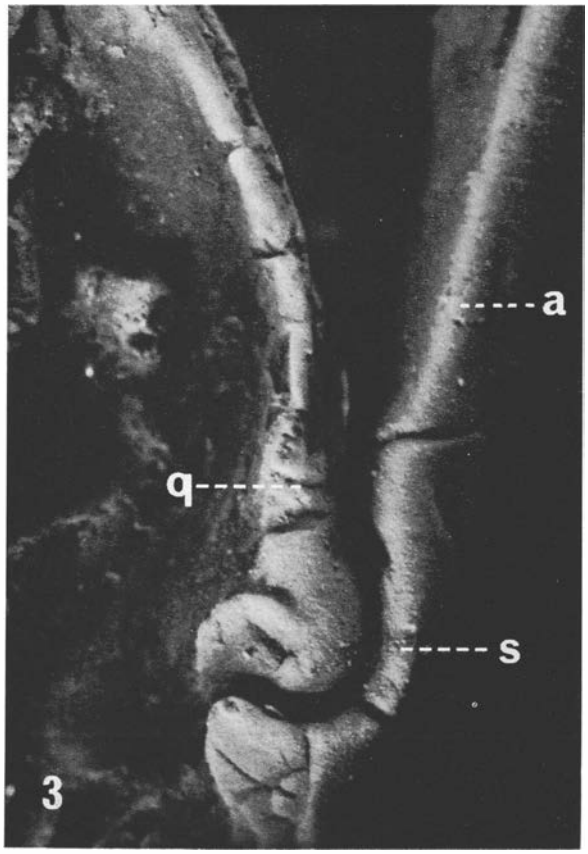


Plate II





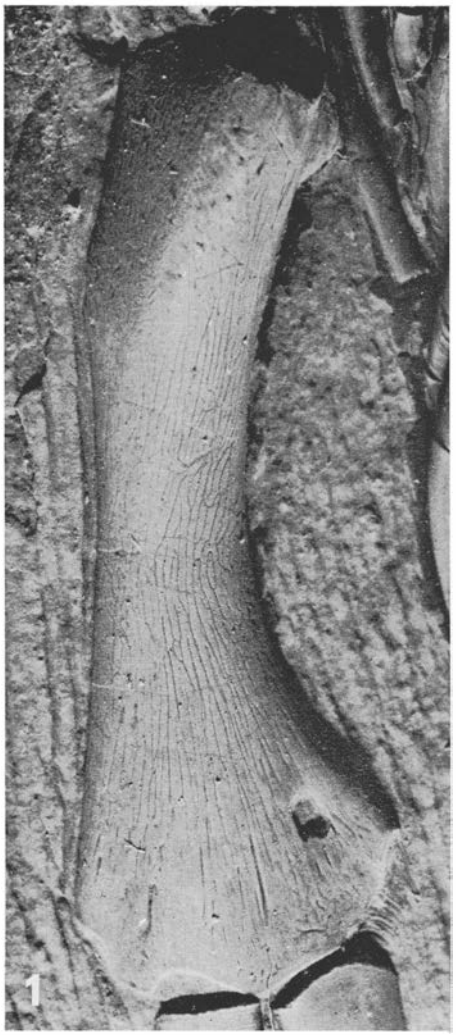

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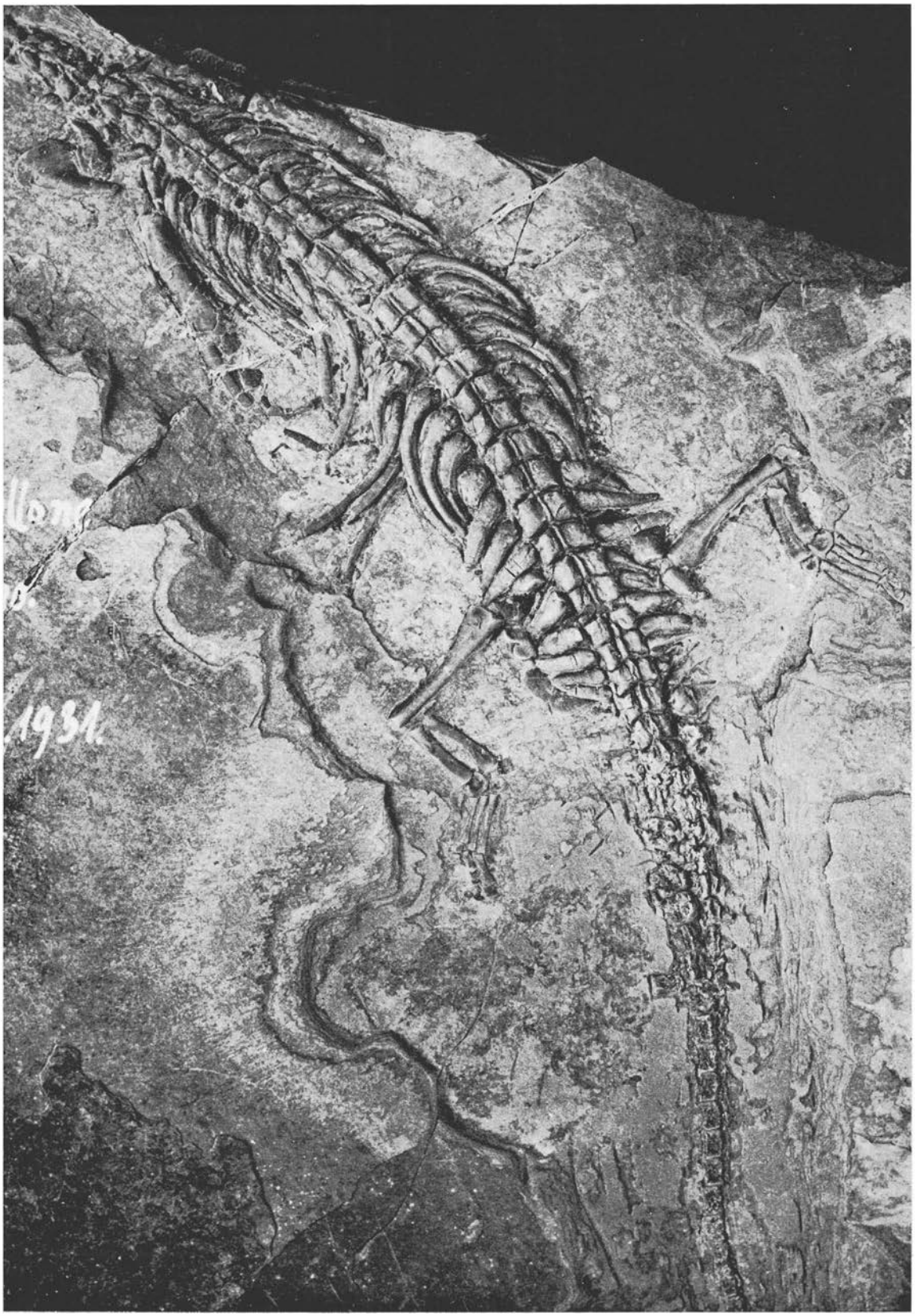
Plate IV

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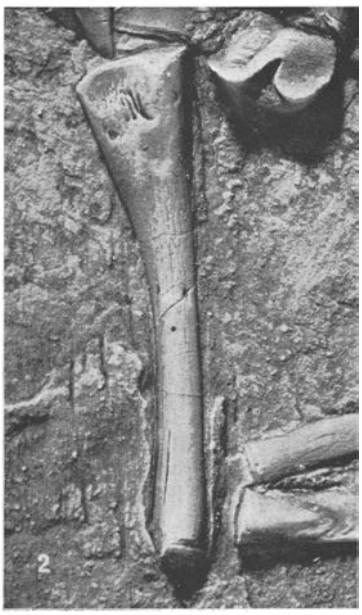
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