

ON
A NEW FOSSIL LIZARD
FROM LESINA
BY
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Über einen neuen fossilen Saurier aus Lesina.
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Among the numerous and diverse fossils which the often very rich localities of the different sedimentary rocks in the territories of Austria have hitherto produced, the order of Saurians is as yet extremely rarely represented. Besides *Palaeosaurus sternbergi* (H. v. Meyer, 'Fauna der Vorwelt' II, Pl. 70), a lacertid which was found in a red sandstone perhaps belonging to the Triassic and on which Fitzinger (1837) published, a find has been made known from the Rhaetian stage, which comes from the Tyrolean limestone alps north of the Inn near Seefeld, and is held in the Ferdinandeum at Innsbruck. Kner (1867) has described this specimen as *Teleosaurus tenuirostris*. The rare and interesting presence of an ichthyosaur at Reifling an der Enn in Steiermark has also been mentioned many times. As is well known, P. Engelbert Prangner discovered it himself in the strata of a grey, nodular and lumpy limestone comprising first a *hornstein*-producing pebbly limestone with ammonites and then a crumbly dolomite, and belongs to the Muschelkalk of the lower Triassic, Stur's 'Reiflinger Schichten'. W. Haidinger had, with Patera, seen this saurian still *in loco* on 12 September 1842. Later it came to Edmont. It was recognised as *Ichthyosaurus platyodon* by Hermann von Meyer (1847). Prangner gave an announcement on it at the meeting of the German Scientists and Doctors at Prague (Vol. 3: 362). Unfortunately this highly valuable original was completely destroyed in the great fire of the Benedictine monastery in Admont in April 1856.

Dr. E. Bunzel has recently published in these proceedings (Vol. 5 (1): 1-18, Pl. I-VIII) the results of detailed studies on the memorable occurrences of saurians in the 'new world' near the Vienna new town. Further, Suess has recognised as the phalanx of a saurian a bone fragment, which was found at St Veit near Vienna, in the neighbourhood of the Einseidelei [brewery?] on the street leading to it, beside which other petrifications indicative of the lower Liassic were found.

Hence, it was very good news to hear of the discovery of a new fossil belonging to this [group] in the far south of the Austrian Kaiser-state, on the island of Lesina in Dalmatia. The quarries there are in a light, yellowish grey, matt, dense limestone which is laid down in thin slabs of mostly one to three centimeters thick, and shows a covering of red iron oxide on the joints. These thin slabs recall the lithographic slates very much in their appearance and at times have been referred to as such (Heckel, Denkschriften der Wiener Akademie 1; cf. also Partsch 'Dalmatien' Vol. I: 18). Fish remains have previously been made known from them, and such were just recently obtained by the Museum der k. k. geologischen Reichsanstalt. The city museum at Zara possesses many earlier specimens of this kind, very fine slabs are also in the possession of Professor Carara in Spalato and the kaiserliche mineralogische Hofcabinet in Vienna (Heckel, loc. cit.). The limestone slabs mentioned have fairly flat surfaces, or slightly curved into waves in some places, and hence also in transverse breaks the reddish lines of iron oxide show a slightly winding, uniform course.

Now in these rocks at Planivat near Verbosca in the years 1869 and 1870, two slabs with the beautiful remains of a new reptile were found, which form the subject of this publication. It is an insufficiently recognised service of Herr Julius Bigoni, master of *Waggerschiff* No. 8 on the island of Lesina, that he retained these peculiar remains and magnanimously sent them as a gift to the palaeontological collection of the k. k. geologisches Reichsanstalt. One of the two stone slabs, which I designate A in the following (Pl. XX) was discovered first and sent to Vienna. The other slab B (Pl. XX) was added about a half year later to the day, and offered an extraordinarily welcome completion for the studies which had meanwhile already been started on the first.

Slab A (Pl. XX) shows the skeleton of a reptile in dorsal view. Nothing remains of the skull of the animal, the cervical vertebrae are disarticulated and damaged, only small components of the right forelimb can be recognised, while the left, as well as the shoulder girdle, are completely absent and only a trace of the supposed sternum is showing. On the other hand the dorsal section of the vertebral column, with the exception of two most anterior dorsal vertebrae and the true ribs belonging to them, is well preserved and in a position such that the upper or dorsal side of the skeleton comes to view, while the lower, the ventral side, is fused with the stone slab. Lumbar vertebrae are not present, rather there follow immediately after the rib-bearing vertebrae two sacral vertebrae, on the left of which the pubis (*Schambein*) and ilium (*Darmbein*) of the pelvis show themselves, on the right only the latter [note that the plate, being a lithograph, is mirror-reversed]. The hindlimbs, particularly on the right side, are preserved in particularly fine condition. Only the upper end of the right femur is covered, which is exposed on the left side. But the shaft and the lower end, as well as the right tibia (*Schienbein*) and fibula (*Wadenbein*), the tarsus (*Fusswurzwel*), metatarsus (*Mittelfuss*) and the phalanges are preserved in the bone substance, the latter as far as minor places [??], [but] on the left side recognisable in part only as impressions; but the left foot is damaged, and its components are scattered on the slab. Twenty-four vertebrae are preserved of the caudal portion of the vertebral column, of which the first three still have an orientation agreeing with the preceding vertebrae, namely in that they lie with the upper or dorsal surface turned upward and free, but with the lower or ventral surface facing downward and fused with the rock. From the fourth caudal vertebra on, their centra lie on their sides, with their left faces turned upward, so that the lower and upper spinous processes become distinctly visible and their shape, at least partly as impressions, can be well seen.

The other, later discovered slab B (Pl. XX) contains the skeleton of the head, the neck and the dorsal part of the vertebral column as far as the sacral region, for the most part with the ribs belonging to it, in contrast only hardly recognisable traces of the forelimbs and perhaps of the pelvic girdle or the hindlimbs, and nothing more of the tail. The orientation of this individual is the opposite of that on Slab A. Namely, this one is pressed with the upper or dorsal side to the mass of rock and fused with it, while the under or ventral side of the

skeleton is turned upward towards the free surface of the slab. Accordingly the underside of the very compressed and damaged skull, the lower surfaces of the cervical and dorsal vertebrae and the ribs appear in the corresponding orientation, mostly only slightly altered from their natural positions.

If one undertakes an exact comparison of the two slabs just discussed in general outlines, as arises especially from the anatomical description following below, not only do the parts of the skeleton of the same name appearing on both slabs show complete identity of their special properties, but the bones found only on one or the other slab alone also show such agreement in relation to those shared parts as perfectly correspond to both forms belonging together in one species, so that no doubt exists that both species are to be classed as one and the same species. Moreover both also seem to belong to fully grown individuals, as the length of the dorsal portion of the vertebral column in them shows exactly the same length of 28.5 cm, and the same size and strength of the ribs allows us to conclude an equal development of the width of the trunk in both.

If one now seeks to determine the position which this reptile has to take up in the zoological system, according to the details laid out in the skeletal description further below, its saurian nature is indubitable: according to the presence of two sacral vertebrae, the properties of the pelvic bones attached to the latter, and of the extremities, and due to the significant number of its procoelous vertebrae, especially in the tail. But it belongs to the true sauriens or scaly lizards (*Schuppenechsen*), as in the crocodiles there are ribs present on all the cervical vertebrae, which are here absent at least on the first [few] of these vertebrae; moreover the crocodiles have lumbar vertebrae, which are not present here, and a doubled articulation of the ribs with the corresponding vertebrae, while here there are simple joints; finally the crocodilians bear only four well-developed toes on the hindlimbs, while we here count five well developed toes. It is self-evident that there is no need to think of enaliosaurians, which had no separate toes, or pterosaurs with their weak trunk, mostly little-developed tail, and the very strong saber-like elongated outer finger of the hand.

Among the saurian families only the lacertines or true lizards have a similar structure of the feet to that our reptile shows, namely five toes provided with curved, laterally compressed claws, among which the fourth toe, provided with five phalanges, exceeds the others in length. Hereby the lacertines differ, as is well known, from the Ascalabota - which also never reach such a size - with their short almost equal-toed feet, as well as from the Chamaeleontids with slender toes split into two opposable groups. Finally, our fossil can not be brought together with the family of Iguanoids on account of the significantly high number of its vertebrae in the trunk and tail - a differentiating character which also applies for the previously mentioned families - which only the largest forms of lacertines meet, namely the *Warnechsen* or monitors.

A closer comparison of our fossil with the skeleton of species from this group of lizards also shows an unmistakable agreement.

The number of vertebrae lying anterior to the sacrum [*Kreuzbeine*], all rib-bearing, thus dorsal vertebrae, the shape of these vertebrae with their anteriorly concave and posteriorly convex articular surfaces, the barely indicated transverse processes, the broad spinous processes, of which here only the broken surface at their base appears, as well as the form of the articular processes [zygapophyses?] and the orientation of their articulating surfaces, the form of the pelvic and limb bones, are all in complete agreement with the corresponding organs of the *Warnechsen* [varanids]. The projecting, long upper and lower spinous processes, distinct in the lateral orientation of the tail on slab A, allow us to conclude a considerable vertical extent of the same together with slight width. It was also without doubt provided with a keel supported by the dorsal spinous processes, and with well-developed musculature, and served as an excellently suited propulsive organ, a property which corresponds to that of the genus *Hydrosaurus* erected by Wagler*, in contrast to the related forms with almost round and unkeeled tails, or only compressed near the tip, of the genus *Psammosaurus* (Fitz.) Wagl. All of the forms differentiated by Wagler into the two named genera had, as is well known, been earlier combined by Cuvier in his genus *Monitor* and later by Merrem as *Varanus*.

The head of the fossil shows at first a surprising similarity with that of a recent *Varanus* from Sydney (Pl. XXI, Figs C, D), of which a skeleton is found in the Zootomical Institute of the university here, prepared from a specimen obtained from natural-history trader Salmin in Hamburg, without nearer determination of the species. Like this recent animal our fossil possesses distinctly visible, triangular teeth, some distance apart, grown onto the sides of the jaws (pleurodont), while there is nowhere any sign of palatal teeth. Also the sharp blades of the teeth on their anterior and posterior edges, as well as the striping of their surfaces [plicidentine], is the same in both species. Even the dimensions of the skull, in whole and in its parts, are hardly different in the two forms.

The inclusion of the saurian of Lesina in the genus *Hydrosaurus* Wagl. is hence fully justified.

But as much as there is agreement of the head with related creatures of today, the proportions of the other parts of the skeleton differ as widely, and especially also in the number of vertebrae, from the other species of the lineage indicated. The limbs on our fossil are conspicuously shorter than in any *Varanus* known to me, while the development of the vertebral column, with regard to the size as well as the number of individual vertebrae, is relatively extraordinarily significant. Thus the Sydney *Varanus*, with a surprisingly similar skull structure to our fossil, has only twenty dorsal vertebrae, while the Lesina species has the total of thirty such in common with the Nile monitor, but the latter is distinguished,

* *Systema Amphibiorum* 1830. The name *Hydrosaurus* (, water and , lizard) was first brought into use by Kaup in the *Isis* 1828, but in another sense than Wagler's.

among other features, especially by its posteriorly more rounded, conical, not sharp cutting teeth. The relatively very short limbs together with the powerful development of the trunk and tail are characteristic for our fossil among the forms with sharp cutting teeth, so that we must recognise and especially designate it as a distinct form of lizard standing closer to the ophidians in the indicated characters.

The systematic name "*Hydrosaurus lesinensis*" derived from its locality might well seem appropriate for this extinct species.

With regard to the original way of life of the animal, it was predominantly allocated to the water, in which as a skillful swimmer and agile diver it would catch its prey, which according to the nature of the teeth, more suitable for cutting but less for tearing or crushing, may have consisted of insects, soft-bodied animals, eggs, cartilaginous and smaller bony animals and the like. It alternated its residence on muddy river banks and on the nearby land with that in water only in slow and sluggish movements by means of the short extremities, which were supported by a winding, undulating motion of the long trunk and the considerable tail in ophidian fashion.

After death the animal was probably, in a state of decomposition, washed by river currents into nearby still bays of the sea and there enclosed in the slowly settling calcareous muds.

A conclusion as to the time when the latter process may have taken place can probably not be drawn from the properties of the animal remains themselves, as saurians of the same or a very closely related species, for instance in rock strata of a determined age, have nowhere yet been found. On the other hand the fish remains already mentioned above, which have repeatedly come from just those limestones in which *Hydrosaurus lesinensis* is enclosed, are fortunately such as allow a comparison with other identical or highly similar forms from determinate geological time periods. Namely, the fish species which come most often from the quarries on Lesina are also found in the bituminous *Mergelschiefern* of Komen in the Istrian Karst. They were first described by Heckel (1850), on account of the similarity in the form of the elongated body and in certain properties of the tooth structure with the recent clupeoid genus *Chirocentrus* Cuv., as *Chirocentrites microdon*, though later by the same author (1856) referred to the leptolepid genus *Thrissops*, but finally held by Kner (1867) to be a form standing closest, if not identical, to *Spathodactylus neocomensis* Pictet. One may now let one or the other determination stand as correct, but in any case it remains completely beyond doubt that the fish remains from Lesina are identical with forms from the black bituminous *Mergelschiefern* of Komen reckoned to be from the Cretaceous formation (see Jahrb. d. k. k. geol. Reichsanstalt **10**: 11 ff, 1859, and **18** (1): 33, 1868), as well as extraordinarily similar to fish from other determined Cretaceous localities. But from this it follows also with fuller evidence, that the limestones of the quarries of the oft-named Dalmatian island, which contain the new saurian described here with and beside the just-

mentioned fish fossils, likewise belong to the Cretaceous formation, and probably must yet be included in the lower Cretaceous, the upper Neocomian.

DESCRIPTION OF THE SKELETON

A not slight difficulty for the detailed study of these fossil remains arose from the manner of their preservation. Namely, the bones are to a large part sunk into the surrounding mass of limestone or covered and enclosed by tightly attached crusts of the latter. Despite oft-repeated and laborious attempts* of different kinds, employing mechanical and chemical means, it was not possible, by far, to expose the parts of the skeleton and free them from the encrusting substance as completely as would be wished. So I finally decided to stand off from further time-consuming and yet resultless attempts, and to provide the description of the fossil remains as far as such is possible with the present covering. Here I can scarcely express my friendliest thanks to my friend and colleague of many years, the k. k. University Professor Herr Med. Dr. K. B. Brühl, for the special willingness with which he made available to me the collections under his direction within the Zootomical Institute of the University here for the purpose of comparative studies, as well as for the typical liberality with which he allowed me the use of the relevant preparations.

THE HEAD

Of the four main posterior bones which in the reptiles surround the *Foramen occipitale magnum* in a closed ring in a distinctly vertebra-like manner, only the lower (*Os*

* Attempts with even the finest chisels, due to the toughness of the calcite and the considerable brittleness of the bone substance, proved too dangerous for the latter, as a more extended use could have been made of a mechanical method, namely just at those places, such as e.g. the skull and suchlike, where a further covering would seem most welcome. I hence restricted myself to removing the covering mass of rock by means of these methods, as far as this could be done without damaging the bones, and then endeavoured to obtain a better success by chemical means. I first used dilute, later concentrated acetic acid, and let this work for a long time on the calcite and bone substance at the same time in less important, limited places carefully bordered with wax. However [Allein], apart from the unusually slow working of the acid, there was also a more intensive dissolution of the calcium carbonate noticeable, though it did not proceed to the wished-for extent in proportion to the solubility of the calcium phosphate of the bones, but rather both were attacked by the acid in scarcely different ways. Also attempts with hydrochloric acid and later with sulfuric acid, first in dilute, then in concentrated form, gave no happier result. I let these liquids work by means of frequently changed, sharpened pegs of hard wood, so that I was able to apply the solution medium to very small dimensions and with repeated gentle friction. However along with the encrusting calcite crust this always also dissolved the bone substance enclosed by it, which lost its shape and sculpture so that a further determination of the affected parts of the skeleton would no longer be possible. Only subsequently did I become aware of Heckel's preparation method, published in the *Denkschriften der mathematischen Classe der kaiserlichen Akademie der Wissenschaften in Wien*, Vol. 11: 188, remark 2, which at the time had only been used for fossils of fish. After my protracted and laborious attempts, in which essentially the same means came into use, I am convinced that an attempt carried out exactly according to Heckel's instructions would also not achieve a more favorable result in the given case, if it did not have as a result the jeopardizing of the fossil itself. Incidentally Heckel remarked expressly that his method had shown itself to be especially successful with the fossils of the bituminous limestones, the so-called *Schieter* of Komen, which stone possesses a far slighter hardness and toughness than our kind of rock from Lesina.

basilare) or centrum is indicated, of which the right, lower surface projects somewhat out of the limestone incrustation (Pl. XXI, Fig. B, ob). Of the two lateral occipitals and the upper one no trace is visible, as they are sunk deeply into the slab and covered with rock, whose removal is impossible. This applies also to the sphenoid [*Keilbein*] of which the two lateral articulatory processes for attachment to the pterygoids seem to be indicated by prominences (Fig. B, s and s [note: in this and following citations the figures on Pl. XXI are always understood]).

Lateral to the main posterior bones and the sphenoid bordering them anteriorly, one sees two joint-?processes [*Gelenkerhabenheiten*] projecting freely (Fig. B, q q) which correspond to the quadrates [*Paukenbeinen*] (*Os tympanicum s. quadratum*), probably displaced somewhat anteriorly and closer to the midline, and which show at the lower ends the joint surfaces for articulation with the lower jaw. On the left side (Fig. B) the articular piece (*Os articulare*) of the lower jaw can be seen with its ventral and part of the inner surface, and its articular facet for the mentioned process [i.e. quadrate] turned towards it, if no longer exactly in the position corresponding to that necessary for articulation in the living animal.

The pterygoids appear on slab B (Fig. B, pt) with their anterior parts, sutured to the palatine and ectopterygoid bones, and allow the pronounced furrow on the ventral surface for vessels and nerves to be quite well seen, similarly as in the Sydney *Varanus* but less like *Monitor niloticus* among others. The first-mentioned sutures are covered with a calcite crust, as are also partly the posterior processes, extending as narrow curved crests towards the lateral articulatory processes of the *Sphenoideum basilare* and the *Os tympanicum*, which have been broken away from the anterior parts by pressure in the region where their attachment to the columella took place, [now] forcefully cut off.

Of the other bones of the skull capsule there is no more to recognise or indicate, even only with some probability. The two narrow bones, curved weakly in S-shapes, brought out of their normal position [to lie] posteriorly against the vertebral column (Fig. B, qj?) may perhaps correspond to the somewhat curved columellae, or the postfrontals [*Hinterstirnbeine*] (*Os frontale posterius*) and squamosals [*Schuppenbeine*] (Cuv. *Os quadratojugale*) united into an arch, the upper temporal arch (*Schläfenbogen*), the posterior end of which, as is well known, in all reptiles serves for the attachment of the upper end of the *Os tympanicum* or *quadratum* lying against the skull (transverse process of the *Occipitale laterale* and *Os mastoideum*). [JS: ALL WRONG, AS THESE ARE OBVIOUSLY THE HYOIDS IN SITU.]

Of the left lower jaw, the lower edge and part of the inner surface can be recognised. One notices (Fig. B, ar) the posterior rounded-off end of the *Os articulare*, and somewhat further anteriorly and medially from it, its bony projection which bears the articular facet, here not visible, with the *Os tympanicum* or *quadratum*. The *Os complementare* with the

coronoid process is also hidden; small pieces of bone lying further anteriorly seem to belong to the *Os angulare*, the *operculare* (op [=splenial]) and the *dentale* (d). On the last, the groove for vessels and nerves along the lower edge can be clearly recognised; the articular piece mentioned above also shows a similar depression [JS: =DORSOMEDIAL EDGE OF THE ANGULAR], while due to the indicated position of the lower jaw, directed vertically against the slab, there is nothing to see of its teeth.

The right lower jaw is moved quite out of its normal position, with its inner surface pressed to the slab and its outer surface visible almost in its whole extent; it is kinked at the suture between toothed part (d) and supraangular part (sa), and these parts are inclined to each other at a laterally open obtuse angle. The upper jaw bone (mx) of the same (right) side lies with its tooth-bearing edge closely against the *Os dentale* (d) of this right lower jaw, so that its teeth partly somewhat overlap the outer surface of the lower jaw. The premaxilla (pmx) is fully encrusted, traces of the lacrimal (l) and the anterior end of the jugal (ju) can be seen attached to the jaw, as well as a somewhat projecting [piece of] bone substance which according to its position and distance is with high probability to be interpreted as the posterior free end of the jugal arch.

Thus it is shown that the skull, which appears with its upper surface turned downwards against the slab and sunk into it, but its lower surface facing upward, [has] the upper jaw part forcefully separated from the frontal region and on the right side, together with the matching lower jaw, turns with the outer face both outward and upward against the slab, downward in relation to the orientation of the animal.

On the right jaw, further, the posterior end (ar') belonging to the *Os articulare*; the *Os supraangulare* (sa) with the prominence adjacent to the joint; located anterior to the latter an opening (f), *foramen nutritium*, for blood vessels, and 14 mm anteriorly a second such opening (f'), are distinctly visible, which indicate the vicinity of the suture between the *Os supraangulare* and the *complementare* [=coronoid]; the latter with its *Processus coronoideus*, though, is totally coated by calcite encrustation. On the opposite side of the last-mentioned opening, namely at the lower edge of the jaw, one notices the *Eckstück* (*Os angulare*, an) as a small bone ridge, partly loosed from its attachment with the *Os supraangulare*.

Four of the teeth especially project in the middle part of the upper jaw. They are triangular, up to 1.5 mm long, entirely laterally compressed, anteriorly and posteriorly with sharp, not denticulate* cutting edges, with the sharp tips curved weakly posteriorly and downward. The enamel covering is quite well preserved and allows a distinct furrow-striping [*Furchenstreifung*] of the outer surfaces of the teeth to be recognised, which extends quite far

* Most monitor species with sharp cutting teeth have very fine notches on the blade, which in some cases are only recognisable under the loupe. The blades of the teeth in our fossil show themselves in the latter case not notched, with which the species from Sydney agrees, which shows no uniform notching even with 20x magnification, but rather a random unevenness of the edge.

towards the tooth tips; this corresponds to the structure of the upper jaw teeth in similar recent forms with sharp cutting teeth (e.g. the *Varanus* from Sydney), in contrast to the lower jaw teeth [which are] smoother near the tips. The separation of the teeth from one another comes to approximately one millimeter.

The teeth, according to their structure, are suited more for cutting of the food, less than tearing up of hard parts, crushing bones or the like, so that our animal may have lived on softer animal food, on molluscs, insects, cartilaginous fish, eggs or only on small bony animals, as was already proposed in the Introduction.

Of the other teeth in the upper jaw, as well as those of the lower jaw, only indistinct traces are present, but these let us recognise throughout the given characters of cutting teeth, while the Nile monitors show a more conical structure, especially in the posteriorly positioned teeth, with rounding of their anterior and posterior sides.

VERTEBRAL COLUMN AND RIBS

The structure of the vertebral column can be determined quite well from the simultaneous study of both slabs.

Cervical vertebrae

The vertebrae of the neck are recognisably present only on slab B, which bears the head, and while very strongly encrusted, [they are] to be differentiated according to their number, orientation and main dimensions. They are nine in number, of which the three last, as indistinct bone remains lying adjacent seem to indicate, were probably provided with so-called false ribs, analogously to the living related monitors.

The first cervical vertebra (co_1) is especially visible on the left side with its under surface increasing in width laterally. Of the three pieces of bone [*Knochenspangen*, '*Spange*' = clasp, bracelet, barrette (?)] which form this vertebra, there appear here the lower piece and the adjacent, triangular, posteriorly pointed part of the left-side upper piece, which are fitted for articulation with the odontoid process of the second cervical vertebrae. From the second cervical (co_2) to the fourth (co_4) inclusive, likewise predominantly the left side of the lower surface is seen, as these vertebrae have been rotated to the right by pressure, while the following, namely the fifth (co_5) to ninth (co_9) cervicals are oriented with their under surfaces fairly parallel to the surface of the slab. The ridge- or comb-like processes* projecting from the lower surfaces of the vertebral centra, which characterise these as cervical vertebrae and differentiate them from the thoracic vertebrae, with their posterior end expanded and finally rounded-off, are quite recognisable on individual vertebrae, particularly the seventh, as well as the eighth and sixth, but on the others mostly only indicated by broken surfaces. The latter also applies to the smaller triangular process projecting ventrally at the anterior end of the

* Hypapophyses of the English anatomists.

second cervical vertebra. So much can be determined about the articulation of the vertebral centra: that a convex joint surface at the posterior end articulates with a corresponding concave one in the anterior end of the following [centrum]. The articulating facets of the two anterior articulating processes seem to have faced inwards and upwards, the posterior facets contacting them outwards and downwards. One can recognise the former on certain vertebrae, e.g. the eighth (co₈), and notice how they extend anteriorly, over the moderately developed transverse processes on both sides at the anterior end of the centrum, to establish the said articulation. The first and second cervical vertebrae are together one centimeter long, the length of the third to the sixth is nearly the same and measures approximately 0.75 mm for each, thus 3.00 cm for the corresponding section of the vertebral column. The last three cervical vertebrae, though, seem to be gradually shortened by about 0.02 cm in the middle, so that the length of this piece of the cervical vertebral column makes up only 2.20 cm.

Dorsal vertebrae

The section of the vertebral column now following contains 30 vertebrae on slab B (Fig. B), though the last of these is preserved only as the fragment of the anterior end of its centrum and the slab cuts off. On all the vertebrae one sees ribs attached, though less distinctly on the last few, so that by this property they are shown to be true dorsal vertebrae.

This is seen even more distinctly on slab A (Fig. A), where the addition of ribs also to the vertebra immediately preceding the sacrum marks them indubitably as dorsals and shows that lumbar vertebrae were not present. This peculiarity agrees well with the present forms of the monitor group, which likewise, if not exclusively among the other lizards, possess no lumbar vertebrae.

One will hardly fail to restrict the number of dorsal vertebrae of our fossil to thirty, even though this figure can not be determined with full certainty even on comparison of both slabs, as on one slab (A) the anterior, on the other (B) the posterior end of the dorsal portion of the vertebral column appears not to be sharply and surely bounded. Now on slab B the ribs decrease in their size proportions such that the 27th and 28th dorsal vertebrae, which are well exposed particularly on the right side, perfectly correspond to the third- and fourth-last ribs on slab A, and can be taken to be identical with these; incidentally the sizes of the corresponding vertebrae, especially their lengths which can be estimated most exactly, are also the same. The fourth- and third-last vertebrae on slab A are hence to be held the same as the 27th and 28th of slab B, and the fragment of the thirtieth still present on the latter considered to belong to the last dorsal vertebra. On this assumption, which without doubt corresponds to the factual relationships, we obtain for our fossil the same number of dorsal vertebrae shown by the Nile monitor, while the *Varanus* from Sydney possesses only twenty of them. The same correspondence also obtains with respect to the number of

cervical vertebrae, of which as mentioned above there are nine present, corresponding to their number in the just-named now-living species.

Slab A shows, as mentioned, the vertebral column in dorsal view, the dorsum with a weak twist about its axis to the right, so that the zygapophyses of the left side are visible more distinctly than those of the right side, while the latter, especially from the region of the 15th dorsal vertebra through to the sacrum, are hardly visible. Apart from the twisting mentioned, the covering calcite crust is also thicker on this side, and moreover the damage to the vertebrae, probably from the removal of the counterpart, is stronger here than on the left side, as shown by the prevalent broken surfaces. On the grounds just mentioned all the upper spinous processes or neurospines are also broken off. Their broken surfaces at their junctions with the upper arch (neurapophyses) show that they were slightly less in length than the vertebral centra. Probably they projected above this robust base, similarly as in their recent relatives, in the form of a rectangular plate of bone and ended dorsally in a linear ridge. The articular facets of the centra, as in the cervical vertebrae, were anteriorly concave, posteriorly convex, which can be inferred distinctly on slab B. The facets of the zygapophyses, remainng in articulation with each other, show a weak inclination to the horizontal level, so the anterior ones face upwards and somewhat inwards, the posterior ones downwards and somewhat outwards. The ribs are attached under the prezygapophyses, but their places of attachment can be recognised distinctly only at few points, such as on the right side of the 18th and 19th dorsal vertebrae on slab B, from which one may conclude that the upper, shallowly hollowed end of the rib articulates on an articular mound, which is located laterally on the transverse process of the centrum. The form of the articular surfaces, as can be concluded from the shape of the ribs, and which the just-mentioned dorsal vertebrae show distinctly, are elongated and rounded with their smaller diameter parallel to the longitudinal axis of the body.

The upper surface of the neurapophyses was only weakly hollowed anteriorly and rose from both sides fairly uniformly to the spine. The under surface of the centrum (slab B) is straight from front to back, or hardly noticeably hollowed, without projecting ridges or similar processes, convex from right to left, and anteriorly on both sides passes gradually into the articular mounds meant for articulation with the ribs. Because of the latter relationship this surface is thus much broader anteriorly than at the posterior end of the centrum, which narrows gradually to form the condyle. The length of the centra increases gradually from 0.75 anteriorly to 1.10 cm posteriorly, so that the whole dorsal portion of the vertebral column measures 28.5 cm.

Ribs

The ribs are mostly well preserved, also in part in their natural positions, only slightly compressed and broken. Even in the latter case the individual fragments are mostly

regularly aligned to each other, only rarely missing, and then their impressions can be seen in the mass of rock. They represent fairly slender pieces of bone [*Knochenspangen* again], whose anterior surfaces, weakly hollowed into a groove along their length, pass gradually into the rounded-off upper side, while the posterior surfaces, more evenly or gently rounded, are bordered from the upper surfaces by a distinct ridge. The lower edge is narrower, somewhat ridged towards the simple upper end of the rib, otherwise rounded. The transversely [i.e. vertically] oval joint surface for articulation with the tubercles on the sides of the vertebral centra were already discussed above. Nothing can be found out about the articulation of the anterior ribs with the sternum from either of the slabs, as they are mostly covered by calcite and only on slab A are insignificant remains present which have been brought completely out of their natural position and are probably to be interpreted as belonging to the sternum (Fig. A, st?). The length of the ribs is most considerable in the middle of the dorsal portion of the vertebral column, and decreases anteriorly towards the neck as well as posteriorly towards the sacrum. The strongest ribs are 5.6 cm long and 0.3 to 0.35 [lapsus, '03.5' in original] cm wide, while the last, most posterior pair of ribs show a length of only 2 cm and width of 0.2 cm. Their number, corresponding to that of the dorsal vertebrae, comes to thirty pairs*, to which presumably can be added those belonging to the last three cervical vertebrae, analogously to today's monitors, do not attach to the sternum and represent so-called false ribs.

Sacral vertebrae

Immediately after the dorsal vertebrae, since, as mentioned, lumbar vertebrae are absent, there follow the sacral vertebrae, two in number, which have a combined length of 1.8 cm and are similar to the dorsal vertebrae in shape.

The first sacral vertebra (Fig. A, s₁), little different in size from the preceding last rib-bearing vertebra, shows on the left side a part of its strong transverse process with its upper surface, then anteriorly the zygapophyses, which insert under the processes of the same name of the preceding vertebra; further, in the middle of the vertebral centrum a rough ridge of bone with the place where the spinous process has broken off, no longer present as in all the trunk vertebrae on the slab, and on either side of this ridge hollows which in the living animals served for the accommodation of muscles. The second sacral vertebra (s₂) shows a similar structure, only it is barely noticeably shorter and less well preserved, particularly more broken at the posterior end of the centrum.

The ilia, which will be spoken of further below in the description of the pelvic girdle, lie on the strong transverse processes of both these vertebrae.

Caudal vertebrae

* On slab A, corresponding to the well preserved vertebrae, there are also only 28 pairs of ribs distinctly visible, the anterior ones are missing or indicated only in traces of fragments.

The caudal piece of the vertebral column, whose anterior part is quite well preserved on slab A (Fig. A), contains the next 24 vertebrae following the two sacrals. The first three ($c_1 c_2 c_3$) have an orientation as shown by the dorsals, namely the dorsal surface facing upward, the ventral pressed to the mass of rock and fused with it. The spinous processes are broken off as in the dorsal vertebrae; already on the first caudals the zygapophyses take up a more vertical position in comparison with the dorsal vertebrae; the transverse processes ($t_1 t_2 t_3$), among which the best preserved is that of the second vertebra on the left side (t_2), are strongly developed and reach a length of 1.4 cm. From the fourth caudal vertebra on, the vertebral column appears on this slab in lateral view, as the tail has been dislocated at the joint of the third and fourth caudal vertebrae, with the dorsal spines turned to the right and the whole right side pressed to the mass of rock. Thus from the fourth caudal vertebra (c_4) on the spinous processes (n and h) are placed in a horizontal orientation and partially preserved with the bone substance on the slab, partially recognisable in impressions, while the transverse processes of the left side ($t_4 \dots t_{24}$), brought into vertical orientation due to the indicated displacement, appear broken off on our slab because [they were] sunk into the counterpart, like the vertically placed *Processus spinosi* of the dorsal, sacral and first three caudal vertebrae. The dorsal spinous processes ($n_4 \dots n_{24}$) are strongly developed, almost rectangular, with bluntly rounded upper ends, the anterior ones one and a half centimeters long and about 0.7 cm wide, decreasing in their dimensions posteriorly only very gradually. Their posterior edge is thicker and rounded, the anterior one thinner and sharper [JS: AS IN PRIMITIVE SNAKES, NOT RECENT VARANOID]. The zygapophyses (za') project quite evidently in the lateral orientation of the vertebrae in such a way that the one at the anterior end of a vertebra with inward-turned joint surfaces covers those on the preceding vertebra with which it is meant to articulate. The left-side prezygapophysis of the 25th caudal vertebra (za'_{25}) is also visible. The lower arch-shanks [*Bogenschenkel*] of the caudal vertebrae (haemapophyses $h_8 \dots h_{24}$) show a not slight development, which formed the caudal canal for the large blood vessels of the tail in the living animal, and end in conspicuously long *Processus spinosi inferiores*. On the most anterior of the laterally-lying caudal vertebrae these are not present and were probably removed with the counterpart in the recovery of the fossil [JS: MORE LIKELY ABSENT!]. They are still left only from the eighth tail vertebra to the twenty-fourth, thus seventeen in number, and are especially visible with their arches and tips on the 16th and 17th caudal vertebrae. One can recognise without difficulty how both arch-shanks articulate, in the manner characteristic for the monitor group, at the posterior end of a centrum by means of two articular facets, so that they almost seem attached to the two caudal centra at the place where they touch. The length of the arch-shanks on the named vertebrae measures 1 cm, that of the tip 1.5 cm, the width 0.2 cm, the decrease of their dimensions is scarcely noticeable in the section of the caudal vertebral column left on our slab, thus up to the 24th tail vertebra. The latter also applies to the centra

themselves, which are 6 to 7 mm long and 9 mm to 1 cm wide. The articulations between the centra, like those of the dorsal vertebrae, allow an anterior concave and posterior convex joint surface to be distinctly recognised.

If we compare the length of the tail-piece of the vertebral column preserved on our slab and the number of their combined centra with the recent related forms*, we can draw the conclusion with high probability that only about the fourth part of the tail is preserved and that its full length may have amounted to about 90 cm. The previously mentioned highly insignificant decrease in the size relationships of the vertebrae, and particularly of their processes - which are conspicuously longer in our fossil than in the related species, and which must have reduced quite gradually to minute size at the tip of the tail - likewise justifies to a great extent the mentioned assumption. The depth of the tail skeleton in the region of the 17th and 18th caudal vertebrae, after the removal of the tips of the lower and upper spinous processes, still measures close to four centimeters. If one considers that the strong, large, upper spinous processes clearly functioned as supporters and bearers of a mighty crest above them constructed of soft parts, it can be gauged what an imposing and powerful propulsive organ our fossil had at its disposal, in the long, deep, dorsally crested and laterally compressed tail, for an easy, rapid and lively motion in the water, in which it preferred to make its residence.

If we now put together the various sections of the vertebral column, to conclude with an overview, as we group them according to the form of the vertebrae as well as their number and dimensions, we find that the *Columna vertebralis* of our fossil is built up as follows:

	Number of vertebrae.	Length in centimeters.
of nine cervical vertebrae, namely		
the atlas	1	0.35
the epistropheus	1	0.65
four cervical vertebrae without ribs	4	3.00
three cervical vertebrae probably with so-called false ribs	3	2.20
of thirty dorsal vertebrae	30	28.50 total length

* The length of the 24 preserved tail vertebrae together measures 21 cm. The tail skeleton of the *Varanus* from Sydney contains 85 vertebrae with a length of 80 cm; the total length of the first 24 caudal vertebrae in the latter measures 18 cm. The estimate of the length of the tail given in the text is set too slight, rather than too high, as illuminated by comparison with the number of tail vertebrae in yet other monitors. So according to Cuvier's counts (Ossemens fossiles Vol. 5, 2), *Varanus niloticus* Dum. & Bibr. contains 83, a New Holland monitor with incomplete tail 65, the monitor from Java (*Varanus bivittatus* Kuhl) as many as 117 vertebrae, which last, in its well-known properties as an outstanding swimmer and diver, doubtless stands very close to our fossil. If we restrict our comparison to the Sydney species and bring the relative length of the first 24 vertebrae in this form and our fossil into relation with the total number of caudal vertebrae in the former, for the latter a total of 98 vertebrae would emerge, of which thus 74 were no longer present, a number which in a similar reciprocal estimation with the monitor of Java would yet notably increase.

whose length in the anterior half of the dorsal section measures approximately 0.80		
cm		
whose length in the posterior half of the dorsal		
section measures approximately 1.10		
cm		
of lumbar vertebrae	0	0
of two sacral vertebrae	2	1.80
of still-preserved tail vertebrae	24	21.00
	in total	65
Probable total of caudal vertebrae gone missing	74	57.5
		<u>69.00 total length</u>
	139	126.5
Total		

This probable total length of the animal of 126 centimeters is quite well compatible with the body length of today's related animal forms. Thus this measures in the Nile monitor five to six feet; in *Hydrosaurus bivittatus* Kuhl inhabiting Java, the Philippines and Moluccas, the Kabaragoya of the Singhalese, four to five feet; in the species from Sydney which served us for comparison 114 centimeters *; further *, in *Monitor gouldii* J.B. from Rockampton and Port Mackay 56 to 130 centimeters; in *Hydrosaurus giganteus* Gray from the same region 67 to 130 cm; in *Hydrosaurus salvator* Laurenti from the East Indies 60 to 118 cm, in *H. marmoratus* Wieg. from the Pelew Islands 115 to 125 cm; and so on.

The adult specimens of the named species thus show a similar body size to that which we assume with good grounds in our fossil.

SHOULDER GIRDLE AND STERNUM

Unfortunately nothing of the shoulder girdle can be recognised with certainty on either of the two slabs. It was probably damaged or partly removed with the counterparts. Yet perhaps one indistinct piece of bone, which lies to the left side of the trunk section (Fig. A, om?) near the sixth dorsal vertebra, can be regarded as a remnant of the shoulder blade.

In the region of the tenth trunk vertebra and the rib of the right side belonging to it, there appears on slab A (Fig. A, st?) a triangular piece of bone, quickly narrowing and ending in a conspicuous point, which with some probability, despite its imperfect preservation, can be interpreted as the median longitudinal piece of the so-called T-shaped bone of the sternum. At its anterior, broader end, near the base of the triangle which that bone represents, there seems to branch off at close to a right angle a narrower, weakly curved side-branch,

* Length of head 5.7 cm (in our fossil 5.8 cm), of trunk 28.3 cm, and of tail 80 cm.

* From measurements of specimens of the Museum Godeffroy in Hamburg. Katalog IV, 1869.

conjecturally the transverse branch to which the cartilaginous parts of the coracoid and the anterior end of the *Omoplata* [scapula] were attached.

ANTERIOR LIMBS

There is only little more of the forelimbs present. On slab B these parts of the skeleton are so encrusted with calcite that it was impossible to uncover them, and the places where the individual elements of the respective limbs could scarcely be indicated. Also on the other slab A, near the anterior end of the vertebral column, where it is snapped and compressed laterally on the right side, so that the individual vertebrae are brought out of their normal sequence and partly damaged, there are on the left side only a few and mostly indistinct remains of the right forelimb present, while of the left one nothing more can be perceived.

The humerus (Fig. A, hu) lies across the vertebral column and shows its anterior, outer surface; the epiphyses themselves are indistinct, especially the lower one. The forearm bones lie one on top of the other at their upper ends, show their anterior surfaces - the radius (Fig. A, ra) as far as the carpal end, while the ulna (Fig. A, ul), which is displaced to the right and laterally to form a distally acute angle with the former bone, lies with only approximately its upper half free.

There is nothing more to perceive of the carpal bones; on the other hand, the metacarpals (mc) and phalanx-bones (ph) are visible in part with their upper surfaces, but in part there appear only the impressions of their lower surfaces. Of the first finger (thumb) there is some amount of bone preserved only at the upper end of the metacarpus and the lower end of the first phalanx, otherwise only the impression remains of both elements; the second of the phalanges, the claw-member [*Klaueglied*, i.e. ungual phalanx], is visible. Of the second finger there appears the impression of the lower end of the metacarpus and that of the first phalanx, the second phalanx and ungual are preserved and lie diagonally in part under the phalanges of the third and fourth fingers. The lower end of the metacarpus of the third finger, and upper end of the first phalanx, are present only as impressions, the other parts, as well as the second, third, and fourth (ungual) phalanges are present in the bone substance. The lower end of the metacarpus and all five phalanges of the fourth finger are visible, but only the first phalanx and the upper end of the second one of the fifth finger, while the ungual of the latter is missing. The number of phalanges, namely 2, 3, 4, 5, 3 following the sequence of the fingers as they have just been described, from first to fifth, corresponds to the numbers of phalanges of the forelimbs of our lizards of today.

PELVIC GIRDLE

Distinct remains of the pelvic girdle can yet be perceived on slab A.

The ilia, which stand in association with the strong transverse processes of the two sacral bones discussed above, are both present though brought out of their natural position by pressure; the one on the right side is partly covered by the vertebral column at its anterior end (Fig. A, il, il'). These *Ossa ilei* show their inner surfaces for attachment to the sacral vertebrae. However, it is not provided with projecting ridges and roughened [areas] as in the present-day *Warnechsen*, the Nile and the Sydney *Varanus*, but rather shows a quite smooth structure in the manner of some Teju-lizards, such as *Podinema teguixin* [=*Tupinambis*].

Of the remaining pelvic bones only the left pubis (Fig. A, pu) is yet present, of which almost the whole inner surface can be recognised with the exception of the anterior end. The latter is again covered by the vertebral column and in the living animal, as is well known, is attached to the like-named bone of the right side through the *Sympysis ossium pubis*. Even the large hole serving for the passage of vessels and nerves, which occurs in the pubis of saurians anterior to the glenoid fossa, and not far from the sutures for attachment with the ilia and ischia, in the so-called neck, can still be seen in our fossil, as well as the half-moon-shaped curve at its lower edge and the similarly formed section on its anterior edge*.

There are no recognisable remains of the ischia; one small bone plate lying laterally beside the left *Os ilei* could perhaps belong to the *Os ischii sinistrum*.

POSTERIOR LIMBS

On slab A the bones of the hindlimbs, particularly on the right side, are found in an especially fine state of preservation. Only the upper end of the right femur with its condyle is covered by the vertebral column, all other bones of the right hind limb are completely uncovered, for the greatest part preserved in the bone substance, and project more or less above the stone slab.

The middle part of the femur (Fig. A, fe) is weakly convex and passes gradually into the expanded lower end. The latter seems fairly flat, without that strongly hollows groove for the tendon of the extensor muscle of the lower leg which stands out in the recent forms of *Varanus*.

The shin-bone (*Tibia*, Fig. A, ti) shows an upper, broader end for articulation in the knee joint and a lower, narrower end for attachment with the tarsal bones. The anterior surface of the tibia is extremely weakly convex and bordered on the outer side by a shallowly hollowed curved line. The inner edge of this surface is even less curved and has an almost straight-line course.

* The bone described in the text is here regarded as the *Schambein*, *Os pubis*, in the sense of Cuvier and later anatomists. Reichert and Gorsky (Über das Becken der Saurier, Dorpat 1852) see the same as a piece of bone foreign to the true pelvic bones, *Osileo-pectineum*, but Cuvier's *Os ischii* as the *Schambein*. Fürbringer (Die Knochen und Muskeln der Extremitäten bei den schlängenähnlichen Sauriern. Leipzig, 1870) regards the *Schambein* as fused with the true *Os ischii* and hence names this bone *Os pubo-ischium*.

The calf-bone, *Fibula* (Fig. A, fi) is narrow at its end facing the knee joint, narrows even more in its middle part, and in contrast shows a very expanded lower end for articulation with the tarsal bones.

There are also small pieces of bone (Fig. A, m, m) preserved in the knee joint, which clearly come from the calcifications of the cartilaginous menisci or the joint-cartilage, such as are also found in present-day lizards.

The carpal bones in the fossil species, as in living related species, are four in number and arranged in two rows. The tibial tarsal bone of the first row (Fig. A, an) represents, as is well known, the astragalus, navicular and the entocuneiform of some mammals and of man, which individual ossicles are thought to be fused into it. Even its general shape here recalls that of the astragalus of ruminants. One sees on our slab its anterior, weakly concave surface with an irregularly trapezoidal outline. The bone is above with the distal end of the tibia and a part of the fibula, laterally with the fibular bone of the first tarsal row, below with the first metatarsus, whose articular attachment is especially distinctly visible, and with the bones of the second tarsal row. The fibular tarsal bone of the first row corresponds to the calcaneum (Fig. A, ca). It also lies in its natural association between the distal end of the fibula, the just-described bone (an), which it meets in a fairly straight-running articular surface, and further the soon-to-be-mentioned cuboid and the fifth metatarsal bone. The second tarsal row contains the cuboid cb and the ectocuneiform cu, enclosed between the tarsal bones of the first row and the metatarsals and articulating with them. The movement of the foot against the lower leg occurred in the living animal at the joint between the first and second tarsal row in the manner of todays lizards.

The metatarsal bone of the first or big toe (mt_1) is quite long, and broad in proportion to the other toes; the second (2) and third (3) are slender and increase in length; that of the fourth toe (4) is only still substantially present at its proximal end, the distal end only appears as an impression. From this state of preservation it would appear as if this fourth metatarsal were shorter than that of the third and even of the second toe, while in the related recent monitors (cf. Fig. H, mt_4) this is relatively the longest. It is probable, though, that this bone was broken and its pieces were consequently displaced, so that it now seems shorter than in its normal state. The slab itslef does not offer sufficient clues for a sure decision, as the bones of the left foot are also badly preserved, brought completely out of their natural position and association, and scattered. The metatarsal bone of the fifth toe (mt_5) shows distinctly its upper surface, is short in proportion to recent forms, expanded at its proximal end, and oriented with the articular facet against the larger bone of the second tarsal row, the cuboid, with which it articulates.

The phalanx bones (ph) show the number present in today's lizards, namely two for the big toe, three for the second, four for the third, five for the fourth and four for the fifth toe. They also correspond to those of the recent relatives in their form. The unguals, only

still distinct on the first and second toes, mostly only visible as impressions on the others, are quite large, concave below (which is recognisable in the second which lies on its side] and somewhat pointed anteriorly [?].

The impression of the first phalanx of the fourth toe shows two longitudinal troughs, corresponding to two prominent ridges on the under surface of this bone, between which the flexor tendon [*Beugesehne*] ran. The ungual phalanx of this toe is poorly visible. On the fifth toe the lower end of the second, and also the third and fourth phalanges, are present only as weak impressions.

Of the left hindlimb, a fragment of the upper part of the femur and some bones of the foot are present, otherwise only more or less distinct impressions. The femur fragment (fe') is badly preserved and in particular the hip-joint is crushed. A part of the anterior surface of the femur is preserved near the middle, the bone itself broken off transversely and its lower part removed. The impression of the posterior surface appears, as far as it comes from the lower part of the middle piece of the femur, as a uniformly hollowed groove. Distally this gradually becomes broader and shallower and finally ends with a weak convexity running transversely, coming from the neck, and with a similar concavity following it which corresponds to the head of the distal or knee joint of the femur.

There are also fine impressions of the posterior surface of the tibia (ti') with the longitudinal hollows of crests on the bone, which occurred for muscle attachment, as well as the impressions of the joint-*Knorren* at the articulation of the knee and of the apophysis at the tarsal joint.

Of the left fibula (fi') the impression of the posterior surface is distinct only at the upper end of this bone, but obscured at its lower end.

The tarsal bones (ph') of the left side leave behind only few distinct impressions; the metatarsals and the toe-bones are brought completely out of their natural positions and scattered; [they] are partly preserved, or there are impressions of their lower surfaces.

There is no trace of the hard parts of the integument, scales or shields, on either of the two slabs. There were certainly cornified parts [*Horngebilde*] of the epidermis present on our animal in life and, as they covered the thickened, peculiarly elevated and folded parts of the dermis, without doubt formed a sculpture similar to that of today's *Varanen*. But the decomposition of this skin tissue probably already took place at a time before the calcareous mud deposited from the water, enclosing the animal's corpse, had hardened.

The principal measurements on the skeleton of *Hydrosaurus lesinensis*, arranged together as an overview, are the following:

	Centimeters
Total length of the preserved part of the skeleton	57.50
Approximate total length of the complete skeleton	126.50
Length of the head	5.80
" " neck	6.20
" " trunk	28.50
" " sacrum	1.80
" " tail, as far as it is preserved	21.00
Approximate length of the complete tail	90.00
Length of the upper jaw to the orbital region	2.00
" " lower jaw	5.50
Width of the skull base in the middle, casually	1.80
" " head at the posterior end (separation of lower jaws)	2.00
Greatest width of skeleton in trunk, nearly	5.00
Length of the humerus	1.45
" " lower arm	1.20
" " hand, casually	1.90
" " ilium	2.20
Width (greatest) of the ilium	0.60
Length of the pubis	1.30
Width (greatest) of the pubis	0.70
Length of the femur	3.00
Width of its upper (hip-joint) end	0.70
" " lower (knee-joint) end	1.00
Length of the tibia	1.85
" " fibula	1.95
Width of upper end of the tibia	0.65
Width of upper end of the fibula	0.32
" lower " " tibia	0.40
" " " " fibula	0.80
" the tarsal articular facet of the fibula	0.40
Length of the foot	3.70
" " tarsus	0.75
" " metatarsal of the first toe	0.84
" " " " " second toe	1.05
" " " " " third "	1.12
" " " " " fourth "	1.00*
" " " " " fifth "	0.51

Total length of phalanges of the first toe	0.92
" " " " second toe	1.33
" " " " third "	1.80
" " " " fourth "	2.20
" " " " fifth "	1.40 (?)

*Somewhat compressed and hence appearing a little shorter, while today's *Varanen* possess the longest metatarsal in the fourth finger.

EXPLANATION OF THE FIGURES

PLATE XX

This plate provides the most true-to-nature possible representation of both fossil finds with a part of the slabs of rock which contain and surround them. The figure, however, is here shown with right and left exchanged with respect to the original, as the lithography was performed without the help of a mirror. Fig. A shows the first-found, so-called trunk slab; Fig. B brings to view the later-found specimen which contains the head. The first shows the remains of our animal from the upper or dorsal side, the latter contains that of a second specimen in the view from the lower or ventral side.

PLATE XXI

For a closer explanation of the anatomical details, on this plate the outlines of the skeletal parts of both slabs A and B are shown in natural size and in the orientation that they present to the observer. The figures are somewhat restored for reasons of clarity only in very few places, such as in the cervical section of the vertebral column in Fig. B. Where the encrusting mass of limestone allows the borders of the parts of the skeleton lying under it to be concluded with greater or lesser probability, the outlines of the bones concerned, e.g. the ribs in Fig. B, are indicated with dotted lines. Bones which have been destroyed or are covered with too much limestone are represented with irregularly broken lines. The broken parts of certain processes, e.g. the neurospines etc., are indicated with similar though sharper and more definitely pronounced zig-zag lines. The figures C to H are given for the sake of comparison and show parts of the skeleton of the *Varanus* from Sydney, which is frequently mentioned in the text. These are all shown in natural size.

[Rest of figure legends omitted.]