[A translation of H. von Meyer (1860), "Acteosaurus Tommasinii aus dem schwarzen Kreide-Schiefer von Comen am Karste," *Palaeontographica (Beiträge zur Naturgeschichte der Vorwelt)* 7(4): 223-231. The footnote in this translation is my own. In cases of uncertainty, the original text is given after the translation, and enclosed in quotation marks, within square brackets; my own clarifications are in italics in square brackets.]

Acteosaurus Tommasinii

from the

black calcareous shales of Comen in Kras

Pl. XXIV.

According to the recent careful studies prepared by Dr. Stache for the Royal Imperial Geological Institute, Vienna, in the *Küstenland* of Austria, the black shales of Komen in Kras, in the area of Gorizia, belong either to the uppermost Neocomian or the lowermost Turonian, in any case, therefore, to the Cretaceous. It is the selfsame formation from which Heckel ("Contributions to the knowledge of the fossil fishes of Austria," Vol. I 1849, p. 17, pl. 6, 7) established the remarkable *Saurorhamphus Freyeri*, a sturgeon ["stör"] that, with the head of a *Saurus* bound to a homocercal tail-fin, represents the type of a peculiar new family of fishes. The reptile figured on Pl. XXIV, Fig. 1, was found in the same shale and was bequeathed to the zoological museum several years ago by the Podestà of the city of Trieste, Mr. Mutius Ritter von Tommasini. The curator of this museum, Herr Freyer, had given over this petrifaction to the Royal Imperial Geological Institute, Vienna, with the wish that it be studied by me, of which Mr. *Bergrath* Franz Ritter had the kindness to inform me in January 1860. The results of my studies were presented in the January 31, 1860, meeting of the Geological Institute (*Jahrbuch der K[aiserlich-]K[öniglichen] geolog[ischen] Reichsanstalt*, vol. XI 1860, p. 22). In Pl. XXIV, Fig. 1, I have represented this petrifaction at natural size; in Fig. 2, the left ilium at thrice natural size; and in Fig. 3 and Fig. 4, the right and left feet, respectively, at double natural size.

The head, as it appears, with a section of the neck as well as the end-piece of the tail, were broken off with the stone. It may therefore be assumed that the skeleton arrived in the deposit complete, which the good articulation of its parts also suggests. But in the anterior region of the trunk the vertebral column underwent separation, and the anterior piece, without the ribs having followed it, that was shifted more to the right. A tiny disruption of the articulation of the column took place in front of the pelvis. These changes are not of the sort that suggest a longitudinal displacement of the limbs; both the forelimbs and the hind-limbs manifestly occupy their original positions. The cervical vertebral count thus reached more than 8 in this animal, and the neck is not only distinguished by a greater vertebral count but also by the fact that these vertebrae become smaller the closer they are to the skull. The impression that the vertebral column makes on the observer is therefore also more that of a snake.

Up to the pelvis, the vertebral column traces weakly sinusoidal or snakelike curves, alternating right and left, in the exposure of the animal from above, which clearly bespeaks an easy mobility in these directions. The tail, in contrast, as far as it is preserved, betrays a stiff posture, possibly only because it is represented only from the side, in particular the left one.

The cervical vertebrae have an average length of 0.004 [*m*], the dorsal vertebrae 0.005 [*m*]; between the two a gradual transition takes place; also they correspond in structure to those of the living Lacertilia ["Lacerten"; *see next paragraph for the reason for my particular*

translation]: the upper [*neural*] arch was very low, and instead of an upper spine-like process one notes only a weakly indicated longitudinal crest. The articular processes [*zygapophyses*] are themselves not especially strongly developed in the cervical vertebrae, and on the corpus of the more anterior of these there is, for the reception of the rib, a mound, which, on the dorsal vertebrae, projects more strongly convexly, whence these [*vertebrae*] also in the anterior section appear broader than the cervical vertebrae. The width of the arch in the posterior area is more like the actual length of the vertebra [i.e., *the length of the centrum*], the anterior width more like the length of the articular processes, which, for the dorsal vertebrae, on average, comes to 0.0065 [*m*]. In the posterior dorsal vertebrae, the anterior width becomes smaller again because of the lesser development of the mounds. The vertebrae were provided with ribs up to the pelvis; the animal therefore possessed no so-called lumbar vertebrae. The ribs resemble those of Lacertilia and snakes; the animal is especially reminiscent of the latter in the nearly invariant length of the ribs, which are all unicapitate and clearly arched; they become more robust at the upper end, upon which a surface is found for articulation with the mound on the vertebral body. The somewhat longer ribs in the middle area of the trunk measure 0.022 [*m*] in length in a straight line, and 0.002 [*m*] in height at the upper articular end. The ribs preserved in the region of the neck are likewise simple, but only reach little more than a third of the stated length. Sternal [“Brust-”] or abdominal ribs I have not been able to determine in this animal.

The separation of the column took place between the sixteenth and seventeenth of the preserved vertebrae. The gap that thereby arose is only a result of displacement; no vertebra has been broken out. Up to the pelvis one counts 35 vertebrae in total. If the 8 anterior ones pertain to the neck, then the dorsal vertebral count in this animal comes to 27. The cervical vertebrae and middle dorsal vertebrae are broken open, like the two [“beiden”] vertebrae in front of the pelvis—the penultimate really only posteriorly, which affords the advantage that one can convince oneself that the body of this vertebra is provided with a strongly convex articular surface, as in the living *Lacerten* [*and so, “Lacertilia” as the translation of this word*]. The last vertebra in front of the pelvis is more strongly broken open; this vertebra, moreover, was somewhat crushed between the vertebrae lying on either side and so appears shorter to the eye. The dorsal vertebrae will have taken up an extent of not much over 0.13 [*m*] in length.

The first sacral vertebra is of the usual size of the dorsal vertebrae; the second, at only 0.0045 [*m*]—which is also the length of the caudal vertebrae, as far as these are preserved—, is somewhat shorter. A fusion of the two sacral vertebrae appears not to obtain. One might be tempted to view the third vertebra as a sacral vertebra also, but the preserved left process appears to be not other than a transverse process, like the anterior caudal vertebrae of lacertilians, particularly Monitor, possess. This process can also be determined on the left side of the three succeeding vertebrae, where it becomes smaller the further posteriorly the vertebra occurs. If the vertebra that follows the two sacral vertebrae represents the first caudal vertebra, then the thin, tall, posteriorly inclined, upper spinous process that distinguish the vertebrae that follow it posteriorly could hardly be discerned on it. The lower arch begins with with the fourth caudal vertebra, where it already appears to have reached the length of a vertebral centrum [“Wirbelkörper”], and further posteriorly it measures more than twice that length. This lower arch was thin, forked, and a little more robust at the end of the fork, and appears, like in the Lacertilia, only to have articulated with one vertebra. As a result of longitudinal displacement [“durch Verschiebung der Länge nach”], it is applied closely to the underside of the caudal vertebrae. There are 17 caudal vertebra preserved, which take up a space of 0.083 [*m*]. The three posterior ones are displaced and crushed [“zerdrückt”]. The height of the dorsal spinous process

on the second caudal vertebra comes to 0.007 [*m*], and in the posterior one it is 0.01 [*m*]. From this augmentation, one can conclude with all probability that the tail must have been a good stretch longer. Here and there on these vertebrae one clearly recognizes the articular processes, the intervertebral cavities, as well as the concave anterior and convex posterior articular surfaces of the only weakly impressed centrum, which were vertically oriented ["Hie und da erkennt man an diesen Wirbeln deutlich die Gelenkfortsätze, die Intervertebral-Löcher, so wie die concave vordere und die convexe hintere Gelenkfläche des nur schwach eingezogenen Körpers, die vertikal gerichtet waren"]; the height of the convex posterior articular surface comes to 0.002 [*m*]. The caudal vertebrae are consistently long.

Of the shoulder girdle apparatus, nothing can be discerned, which is all the more tragic, as it might thereby have been possible better to determine the boundary between neck and body.

The limbs are all directed posteriorly; of the forelimbs, the left one especially is more lateral. The very well preserved left humerus has a length of 0.007 [*m*]; the upper end [*has a width of*] a little more than 0.002 [*m*], the lower end is only subtly ["nur unmerklich"] smaller than the upper end, and the narrowest region of the bone, which falls in middle, is only half as wide. Both ends are blunt, and the upper one, therefore, is not provided with an especially conspicuous capitulum; on the lower end, no lateral hole [*ectepicondylar foramen*] can be discerned; the one side of the the bone is straighter, the other more concave, at least in the upper half. Proximally, this left humerus abuts more laterally against a 0.003[-*m*-]wide bone that is nearly half as tall and somewhat impressed ["eingezogen"] and, according to its position, appears to have participated in the construction of the articular fossa; but, although it seems complete, nothing more detailed can be said about what element this small bone represents. The shape of the humerus was less clearly preserved on the right.

The forearm is 0.005 [*m*] long and has a ratio to the humerus of 5:7. The two bones of the forearm are nearly equally well developed ["stark"], narrow on the whole, and at the somewhat strengthened, blunt ends only 0.001 [*m*] wide. The medial of these bones was straight, the lateral one weakly curved and subtly ["unmerklich"] longer; the latter could be seen as the ulna, but no olecranon process ["Ellenbogenfortsatz"] could be discerned on it.

One clearly recognizes that the carpus disintegrated into little bones, about which, therefore, nothing more detailed can be said. The left hand is displaced and crushed; on the right one can recognize enough to say that it must have consisted of five fingers, whose phalangeal count could not be established. With the carpus and the metacarpus, the length of the hand amounted to twice the length of the forearm; it was therefore shorter than the humerus and forearm taken together.

Because the animal is exposed dorsally, then, of the pelvis, the ischia and pubes cannot be visible. The bone, that medially abuts against the upper end of the left femur, will be the ilium of the same side, which I have illustrated in Fig. 2 at three-fold enlargement. The bone extends posteriorly as a long, strong process and measures 0.009 [*m*] in total length; anteriorly, where it participated in the construction of the acetabulum, it is blunt and reaches a height of 0.0035 [*m*]. The upper margin of the right ilium projects under the dorsal vertebrae and the first caudal vertebra. For its length one arrives at 0.012 [*m*], and accordingly, something might be missing posteriorly on the left ilium; the oval, knob-like part lying in front of it cannot possibly belong to it. Attached to the two sacral vertebrae were strong processes for bearing the pelvis, of which the anterior one was a little longer, and broader laterally where it connected with the posterior one.

The femur constitutes a very straight bone 0.014 [*m*] in length, and the ratio of the humerus to it is accordingly 1:2. On the flat, simply rounded, lower end one measures a width of 0.005 [*m*], and on the upper, blunt end, where no special capitulum was developed, 0.003 [*m*] (somewhat more on the right bone because of a weak angle that appears to betray a kind of trochanter); the weakest region, falling in the middle, measures 0.002 [*m*] on average.

The patella is seen very clearly on the left side, between the femur and shank, as a wedge-shaped little bone that projects from beneath the femur on the right side. The patella was therefore not cartilaginous in this animal but rather made of bone.

The shank, 0.008 [*m*] in length, has a ratio to the femur of 4:7. The two bones of which it is composed appear to have been very flat; the one becomes broader toward the upper end, with a straighter blunting [“Abstumpfung”], whereas the other expands ventrally and thereby ends in a rounded fashion. The broader end of these bones [“dieser Knochen”] comes to somewhat more than 0.003 [*m*], the narrower one 0.002 [*m*], with the narrowest region of the bones hardly half as great; the bone that becomes broader ventrally thins toward the middle more than the other. Only one bone remains of the right shank.

Like the carpus, so was the ankle constructed osseously, but the number of little bones of which it was composed can no longer be discerned exactly. The first row appears, as in certain Lacertilia, to have contained a larger, flat bone, but it could not be determined whether it consisted of two neighboring bones that abutted against one another along a suture or was single. The little bones of the second row, of which there were at least three, were roundish and of different sizes.

The foot consisted of five developed toes. The metatarsal of the fifth toe is somewhat shorter than that of the first toe, which on the whole is a little stronger. The metatarsals of the three middle toes are somewhat longer, and among these the middle one, measuring only a little more than 0.005 [*m*], appears to be subtly longer than the two others. On the right foot, which is illustrated at two-fold enlargement in Fig. 3 and whose metatarsals are better preserved, that of the fifth toe lies on a larger tarsal [“auf einem grösseren Fusswurzelknöchelchen”*!*]. Both feet are turned so that the fifth toe occurs medially and the first toe laterally.

The toes are better preserved on the left foot, which I have illustrated in Fig. 4 at two-fold enlargement. Without the metatarsals, but with the unguals, one find the following phalangeal count, beginning with the first toe: 2, 3, 4, 5, 3, according to which the fifth toe has one less phalanx than in the usual Lacertilia. The phalanges are very similar in length to one another, usually measuring 0.003 [*m*]; toward the end, the phalanges just become somewhat thinner, and by the last phalanx of similar length [*the penultimate*], in such a way that one could take that same one to be the phalanx that first follows it and is conspicuously small [*the ungual;* i.e., *one could mistake the penultimate phalanx for the ungual*]. The five toes were provided with these small unguals. The fourth toe is the longest, nearly twice as long as the first toe; the second toe is longer than the fifth, and the fifth longer than the first. In the incompletely preserved right foot, the pahlanges are partly posteriorly displaced, which causes them to appear longer. Without the ankle the foot measures twice the length of the shank; it was in any case larger than the hand.

The bones were completely transformed into a firm, hard substance with the appearance of steel or manganese: outwardly black, steel-gray beneath and within. They are also provided with fine, linear impressions that run more or less perpendicular to the long axis of the bone and not quite parallel to one another, sometimes therefore bounding wedge-shaped pieces. On the vertebrae, they run more vertically on the centrum [“für den Körper”], and on the the spinous processes horizonatally, that is, even here always perpendicular to the long axis of the bone. In

order give a distinct picture of it, I have illustrated the ilium, with these fine grooves, at three-fold enlargement in Fig. 2, which I did not undertake to do in the illustration of the animal at natural size in Fig. 1, as they would only have caused distraction. Only later did I first realize that, in order to expose the petrifaction more clearly, the stone could be treated with weak nitric acid, whereby these deepened lines become more clearly emphasized. Their origin dates either to the time when the bones turned to stone, or later, when a transformation of the substance of lithification, like of the stone itself, occurred, probably from a carbonate chalk to iron carbonate [*siderite*], and because of their regularity these fine grooves will probably be a result of the disturbed inclination of the mineral during crystallization. The stone is hard, heavy and dense; the plate on which the petrifaction lies is 0.034 [*m*] thick.

This animal is reminiscent of the small saurians of the Cretaceous, which incline to ["hinneigen"] the living Lacertilia because of their concave-convex articular surfaces on the vertebral centra. It has the longish neck consisting of a greater number of vertebrae in common with *Dolichosaurus longicollis* (Owen, *hist. Brit. foss. Rept.*, Part IV, p. 176; Lacertilia, pl. 8 fig. 1, 2 and pl. 9, fig. 4) from the lower Cretaceous of Kent, tow hich 17 cervical vertebrae were attributed, whereas in the living Lacertilia—which view on the number of their cervical vertebrae one may also agree with—more than eight cannot be accepted, rather 4 or 5, seldom 6. These fossil saurians are accordingly Macrotrachela[1] ["Macrotrachelen"] with concave-convex articular surfaces on the vertebral centra; in the mostly older Macrotrachela known thus far, none of these articular surfaces shows a convex structure. Should *Plesiosaurus* be confirmed as Cretaceous, then both kinds of Macrotrachela will have lived simultaneously at this time. The concave-convex articular surfaces do not rule out the residence of this animal in water, as demonstrated by the crocodile and, among the fishes, in *Lepidosteus* [*Lepisosteus*]. The reptile at issue even appears, according to the remainder of its structure, to have lived more in water than on land.

The vertebrae and ribs are similar to those in *Dolichosaurus*, as is the manner of articulation of the same, although they are only half as large irrespective of the fact that the animal was fully grown. The anterior vertebrae preserved in the tail of *Dolichosaurus*, to judge based on the figure, appear relatively longer than in the animal from Komen. And neither could sternal or abdominal ribs ["Brust- und Bauchrippen"] be recognized in *Dolichosaurus*. To deal now with the humerus, in the forelimb, it possesses, according to the figure, this proportional length: it is twice as long as, and so rather stockier than, in the animal from Komen ["Von seinen vorderen Gliedmaassen liegt nur der Oberarm vor, der nach der Abbildung die verhältnissmässige Länge besitzt, er ist daher noch einmal so lang, dabei aber eher noch stämmiger also im Thiere von Comen"]. From this, Owen supposes a shorter forearm and hand and generally shorter limbs more modified for swimming than in *Monitor*, *Iguana* and the living Lacertilia generally. The limbs of the animal from Komen, which are complete, contravene this. Too little is present of the pelvis and the hind-limbs of *Dolichosaurus* for a comparison. Two vertebrae were ascribed to the pelvis of this animal, which I also grant in the *saurus* before me; among the living Lacertilia, *Scincus variegatus* and *Bipes lineatus* possess three sacral vertebrae (Cuvier, *vergl. Anatomie* German. p. 123).

Two pieces of *Dolichosaurus longicollis* were found simultaneously, and in the same quarry of Burham, which landed in different collections and which, Owen believes, are from the same skeleton. The one of these two pieces consists of the mutilated ["verstümmelten"] skull and

[1] I'm not familiar with this apparently taxonomic term. Literally, it refers to "large-necked" animals. He seems thus to ascribe *Acteosaurus* to Macrotrachela, where *Plesiosaurus* also belongs, but notes that the presence of procoelous vertebrae distinguishes the former.

the 36 anterior vertebrae. Drawing to it the second piece, which Owen at first (*Geol. Trans. London*, 2. VI, p. 412, pl. 39, fig. 4) ascribed to his *Raphiosaurus subulidens*, there are 57 vertebrae in the section between head and pelvis (provided that nothing is missing in between), a count that among the living Lacertilia is only matched by Sauria that, like *Pseudopus, Bipes* and *Ophiosaurus* [sic], constitute a transition to the snakes in having only incompletely developed limbs, which in *Dolichosaurus*—to judge from the shoulder blade, which is supposed to have similarity with *Iguana*, and also from the humerus and the pelvis—cannot have been the case. In *Bipes lineatus*, as many as 65 vertebrae were determined (Cuvier, *a. a. O.* p. 123). In the living Lacertilia with well-developed limbs, the number of the vertebrae for this section reaches only 41 (*Scincus ocellatus*). Of the 57 vertebrae between head and pelvis in *Dolichosaurus longicaudus*, 17 were ascribed to the neck, so that for the section between the neck and pelvis 40 more remain, whereas the animal from Komen has only 27 vertebrae in this stretch, a conspicuously lower count. In *Lacerta ocellata* this count comes to 25 (Cuvier), and the other Lacertilia, with the exception of *Scincus*, mostly have fewer. If one assumes 17 cervical vertebrae in the animal from Komen, like in *Dolichosaurus*, of which 8 were preserved, then the neck was barely half as long as the section between it and the pelvis; in *Dolichosaurus longicollis* it [*the neck*] averaged 2.5 times this section.

What could make the association of the two pieces of *Dolichosaurus* found in England doubtful would be that the anterior piece is strongly arched, the posterior one stretched out straight. However, on the anterior piece the posterior end is straight. Still, it is difficult to square the slenderness and flexibility of the animal with the fact that the one half of the vertebral column should have been strongly bent without at the same time inducing a curvature in the other.

We must now consider *Coniosaurus* [sic] *crassidens* (Owen, *hist. Brit. foss. Rept.*, Part IV, p. 175, pl. 2, fig. 18-20) from the middle Cretaceous of Clayton in Sussex, to which a mandible fragment as well as a row of 9 dorsal vertebrae found in the same piece of chalk were attributed. The vertebrae are of the same size, and the centra provided with the same concave-convex articular surfaces, as in *Dolichosaurus*, which, however, is distinguished by its smaller head. The similarity with the animal from Komen, therefore, is not greater than in *Dolichosaurus*.

A third animal also belongs here, which was discovered in the lower Cretaceous of Cambridge and distinguished by Owen (*loc. cit.*, p. 173, pl. 9, fig. 1-2) as *Raphiosaurus subulidens*. The vertebral column ascribed to this animal was later referred by Owen himself to *Dolichosaurus longicollis*. Otherwise, there is only the mandible, which suggests a *saurus* of the size of the other [*elements?*].

Of the lacertilian-like fossil animals, the somewhat older ones from the lithographic shales of the upper Jurassic can now be drawn into comparison. In my study on the reptiles of the lithographic shale of Germany and Franch (1860), I published them in detail. They are all conspicuously distinguished in that, on the body of the vertebra, neither of the two articular surfaces is convex, from which one could conclude the animals were in a more embryonic state, were they not otherwise fully developed. Among those that are similar to the animal from Komen in their more snake- or eel-like shape, *Acrosaurus Frischmanni* represents a much smaller animal (p. 186, pl. 12, fig. 6-10) that was provided with even weaker limbs, and compared to the humerus, a short forearm; it also possessed no fewer than 38 vertebra up to the pelvis and a long tail composed of vertebrae of peculiar form. *Pleurosaurus* and *Anguisaurus* (p. 118, pl. 14), which, together with *Acrosaurus*, make their own family, that of the Acrosauria

["Acrosaurier"], were larger animals with a narrow, cylindrical shape and were clearly distinguished by the numerus, strong gastralia and sternal ribs ["Bauch- und Brustrippen"]; *Anguisaurus* is further distinguished in that the ends of the lower [*haemal*] arch of the caudal vertebrae, which are applied to the vertebrae, are closed by a bony bridge ["durch eine knöcherne Querbrücke geschlossen war"].

Most of the remaining lacertilian-like animals from the lithographic shales are distinguished from the animal from Komen in that their form comes down to that of our usual Lacertilia, from which it fundamentally differs all the same. Among them, *Homoeosaurus neptunius* (p. 105, pl. 12 fig. 3, pl. 16 fig. 1-4) is a much smaller animal, less narrow, and provided with longer limbs, and the forelimbs are hardly smaller than the hind-limbs. The same applies also to *Homoeosaurus Maximiliani* (p. 101, pl. 11 fig. 1-4) and *H. macrodactylus* (p. 103, pl. 11 fig. 5), which were larger than the aforementioned species without, however, approaching the animal from Komen. *Ardeosaurus brevipes* (p. 106, pl. 12 fig. 4, 5) was somewhat smaller and, like *Homoeosaurus macrodactylus*, provided with smaller forelimbs, but they were not so conspicuously tiny as in the animal from Komen. To the deviations emphasized in the Sauria from the lithographic shale, it may be added that the genera *Homoeosaurus, Ardeosaurus* and *Sapheosaurus*, like the living ones, possess one more phalanx in the fifth toe than does the animal from Komen, and that *Atoposaurus*, which likewise cleaved to the small size of the Lacertilia, was only four-toed.

The narrow, long, cylindrical form of the *saurus* from Komen is reminiscent, like *Dolichosaurus*, of the Lacertilians *Pseudopus, Bipes* and *Ophiosaurus* [sic], which constitute the transition to the snakes and are provided with incompletely developed limbs, but the first animal, in the limbs and even in the number of vertebrae, was more similar to the true Lacertilia, in contrast to which, in general, the small degree of development of the nevertheless fully developed forelimbs is conspicuous. The neck corresponds to that in *Dolichosaurus longicollis* in that it is longer and composed of a greater number of vertebrae; there is, howver, no reason that the animal should belong to the same genus. The similarity of the vertebrae says just as little about generic allocation. The smaller size alone of the animal from Komen, in comparison with the three lacertilian-like genera from the Cretaceous of England, which are consonant in size, would only support the adoption of a different species, if, by comparison with *Dolichosaurus longicaudus*, there did not turn out to be a conspicuously smaller number of dorsal vertebrae, which bespeaks a separate genus to whose more secure establishment the admirably preserved limbs and the tail significantly contribute. The appellation *Acteosaurus Tommasinii* occurred to me appropriate for the animal, for it was discovered in the *Küstenland* and was an inhabitant of an earlier coast. Insofar as it is affiliated with the three lacertilian-like saurians, erected by Owen, from the Chalk of England, it simultaneously confirms the view that the matrix from which it derives belongs to the Cretaceous.
