Abhandlungen
der Bayerischen Akademie der Wissenschaften
Mathematisch-naturwissenschaftliche Abteilung
Neue Folge. 9.
1931

Results of the Research Expedition of Prof. E. Stromer in the Egyptian Desert

II. Vertebrate remains from the Baharîje Beds (lowermost Cenomanian).
10. A skeletal remain of Carcharodontosaurus nov. gen.

by

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with 1 figure

submitted 9 May 1931

Munich 1931

published by the Bayerischen Akademie der Wissenschaften
in commission with Verlags R. Oldenbourg, Munich

original translator unknown
1999 editing by Matthew Carrano, SUNY at Stony Brook

On the 13th and 23rd of April, 1914, my collector, R. MARKGRAF reported to me that he had excavated turtle remains and small teeth of *Ceratodus* (*africanus* HAUG) together with a number of remains of very large dinosaurs in the hard, gypsum-free Mergel, 2km from Ain Gedid on the western face of Gebel Harra]: namely, two large limb bones (femora) that were smashed in the middle, three smaller bones (fibulae, one pubis), 3 vertebrae, a broken piece of skull bone (braincase, etc.), a piece of jawbone without teeth (maxilla), and 2 broken teeth (No. 1922 X 46).

The remains, near which were found the weathered remains of crocodiles with blunt, conical teeth (No. 1922 X 51, 52), are salt- and gypsum-free and only partly crushed, and belong, according to the find-records, to an individual of great size and preservation, and are therefore very valuable. They are of brown color, and only a few (the cervical vertebrae) have the marks of surface weathering. But they were the front here incomplete and partly somewhat obviously weathered, e.g. the ends of the pubis and their connecting lamellae. Unfortunately, they had broken into very many fragments during transportation due to insufficient packing, and despite weeks-long work, many fragments could not be set together, because many broken pieces had been lost by excavation and unpacking. Because of this, the work is not only made more difficult, but above all the highest importance of the find is greatly devalued. Because of its peculiarity, however, it deserves an accurate description.

Owing to the uniqueness of the form and the fact that there was too little comparable material in the Munich collection, the work could not be completely fulfilled here. I would like to thank the assistance of the German community and the companionship of friends and researchers at the University of Munich, as well as in Stuttgart, and above all in Tübingen and Berlin where I was employed in previous years by Dr. BERCKHEMER, Prof. v. HUENE, and Prof. JANENSCH, to whom I also owe the greatest debt. I am obliged therefore to thank all those previously mentioned, and thus to them I give attention here. Here I must thank Dr. SCHRÖDER for taking the difficult photographs of the teeth. In the following paper, the skeletal remains belonging to one individual will be described first and compared. Other dinosaur remains, partly belonging to *Spinosaurus aegyptiacus*, perhaps also HIEHER and the largest parts belonging to other dinosaur species, shall be described in a later essay; only then can it be published completely [about the group].

Skull.

A 28 cm long and 14 cm wide piece is the essential part of a small, asymmetrical b r a i n c a s e, Table I, Fig. 4a–c. The left margin is incomplete, and the anterior partition of the braincase, parts of its lateral walls, and even the large ventral partition are missing; only the lateral partitions are nearly complete at the foramen magnum. The sutures are only very weakly visible.

At the rear of the skull, the right exoccipital with the opisthotic is fairly complete. It projects more than 6 cm laterally and slightly ventrally. The main part of the posterior surface stands perpendicular and is somewhat concave, the dorsal part is distinguished by a perpendicular edge from it, however, it is somewhat curved and somewhat visible dorsally at the posterior. Anterior to that, an almost perpendicular suture delimits a lateral continuation of the parietal; the sutures of the supraoccipital, however, are not visible. However, its partition is actually about 3 cm over the lateral margin of the foramen magnum on each side, whose circular boundary is broken and indicated by a round vascular cavity that is also present in *Tyrannosaurus* (OSBORN, 1912, Fig. 4) and *Antrodemus* = *Allosaurus* (HUENE, 1914, p. 578, Table 7, Fig. 3; and GILMORE, 1920, Fig. 4), and that leads anteriorly somwhat inside a canal running to the upper side of the posterior braincase. The dorsal surface of the supraoccipital is somewhat concave and seems higher posteriorly.

About 5 cm above the foramen magnum, the somewhat anterior-sloping posterior side of the skull is narrow and quite convex transversely, with roughness and edges from which the medial nuchal attaches anteriorly as a very large ligament. Here the merged parietals, as the highest part of the skull, form not quite bilaterally symmetrical thick protuberances with approximately square outlines. Its highest point lies nearly 7 cm above the surface of the forehead. Its anterior side, convex anterodorsally, recedes steeply under that to a concavity. Laterally, a sharp suture runs posteriorly beneath an occipital crest, which continues here somewhat outwards as a lateral continuation of the parietal. Ventral to it, the lateral side of the approximately 5 cm high bump recedes to a concavity. The 7.3 cm wide bump is even larger than in *Antrodemus*, *Tyrannosaurus*, and *Ceratosaurus* (GILMORE, 1920, Fig. 1, 2, and 53), where it is distinguished as the crossing point of the occipital and sagittal crests. Its dorsal surface is rough as in *Antrodemus valens* (GILMORE, 1920, p. 14). It is possible to suppose that, for this reason, an unpaired horn rose here. The aforementioned lateral continuation of the parietal upwards onto the opisthotic is present similarly in *Antrodemus* (GILMORE, 1920, p. 14, Fig. 4, 5).

In contrast to *Tyrannosaurus* (OSBORN, 1912, Fig. 2) and *Antrodemus* (GILMORE, 1920, Fig. 5), the frontals are completely coossified as in *Ceratosaurus* (GILMORE, 1920, p. 81); this is also the case with the parietals. Their smooth surface is somewhat arched anteriorly in the middle. The width in front of the horn is 14 cm, but originally it was 16.2 cm; the length was 15 cm. Anteriorly, its margin runs simply convex forward, apparently into a median point, whereas in all the aforementioned species except for *Tyrannosaurus*, the anterior end begins out wide and indented. In lateral view, the frontal is ventrally concave at the anterior end, actually part of the orbital roof, and then thickens through a large ventrally-protruding convexity, in which ran a vessel anteriorly from the medial to the lateral part, and on whose pitted* (GRUBIGER) side the postorbital was attached. Dorsal and posterior to this is the supratemporal notch, which is covered in the middle and posterior by the occipital crest, and under whose lateral edge the anterior suture of the lateral continuation of the parietal is distinct. Anterior to that, no sutures can be distinguished dorsally. Ventrally, however, a suture is visible above the brain cavity running posteriorly from the olfactory bulbs, finally bending itself laterally in order to reach the lateral margin in the breadth of the anterior edges of the parietal bump. This border marks off the frontal from the alisphenoid*. Posterior to the aforementioned place the lateral margin is thinner, and ventral to it the margin is longitudinally concave; a suture runs in the concavity from posteromedial to anterolateral. Unfortunately, the other boundaries of the prootic are not visible. Finally, 5 cm beneath the lateral end of the occipital crest lies the circular opening of the auditory meatus, somewhat ventral to the level of the lateral edge of the frontal.

The b r a i n c a v i t y, Table I, Figs 5a, b, which is only well-preserved in the dorsal and lateral parts, may be best described according to its endocast, which is similar overall to that of *Ceratosaurus nasicornis* and which unfortunately is very incomplete regarding the foramina (GILMORE, 1920, p. 93, Table 36, Fig. 1, 2). The endocast of *Antrodemus* (= *Allosaurus*) and *Tyrannosaurus* (OSBORN, 1912, Fig. 9 and Fig. 17, Table 3, 4) differ greatly. The endocast in question is about 19 cm long from the anterior end of the olfactory bulbs to the dorsal margin of the foramen magnum; at the widest place (large-brain/GROSSHIRN)* it is 5.1 cm wide, and over 6 cm tall not including the hypophysis; therefore it is long and very narrow, and distinctly taller than wide.

The olfactory bulbs are separated by a deep concavity, and diverge at a larger angle than in *Ceratosaurus*. The space for the olfactory tract is narrow and higher than wide. In the case of *Tyrannosaurus*, the bulbs are separated anteriorly only by a narrow bone, and the space for the tract is wider. The actual brain cavity above is very convex longitudinally and transversely. From above, it seems narrower than in *Tyrannosaurus* and *Ceratosaurus*. In the case of *Antrodemus* and *Tyrannosaurus*, it is even more greatly convex longitudinally, and continues dorsally (EDINGER, 1929, pp. 44, 129) into the skull roof, which I am not able to demonstrate. In the case of *Ceratosaurus*, it seems less longitudinally convex dorsally, even receding steeply posteriorly up to the medulla oblongata. At this recess, the aforementioned vascular canal of the posterior skull partition passes through this partition on either side, 1.5 cm from the median line. 2 cm ventral and somewhat posterior to the inner entrance, a similar, larger vascular canal leads posterolaterally and somewhat ventrally to the longitudinally elongated auditory organs, which are completely broken off on the left side of the ventral skull. 1 cm beneath this foramen on the upper right side, there is a larger foramen preserved for the acoustic nerve that leads laterally, somewhat ventrally, and towards the bottom, and most likely led anterolaterally to a lateral entrance.

The proportions in *Antrodemus* (= *Allosaurus* in OSBORN, 1912, Fig. 9) and *Ceratosaurus* (GILMORE, 1920, Table 36, Fig. 1 and 2) are entirely similar, in which the last-mentioned foramen was described as being for the fifth cranial nerve (trigeminal nerve), and moreover in the first-named illustration 2 taps* (ZAPFEN) of the outlet can be seen, with the other 2 corners, which are connected by a vertical edge and must correspond to the exits* for the acoustic nerve and to the overlying vascular cavity. In the case of *Tyrannosaurus*, however, according to OSBORN (1912, Fig. 17, Table 3 and 4) the whole thing lay somewhat farther anteriorly, near the highest points of the brain cavity, and the two upper foramina are also placed anteriorly as blindly ending sacs. However, here the trigeminal nerve has a branch that leaves anteriorly.

Posterior to the middle foramen, the brain cavity narrows on both sides to a width of 2.3 cm through a perpendicular curvature of the wall, behind which the medulla oblongata becomes somewhat wider, however. Unfortunately, the hypophyseal fossa and other foramina are not preserved. However, as proof of these things it will suffice to show the present correspondence of the brain capsule with that of *Ceratosaurus*.

Two strange-looking bones, colored dark-brown by iron, can hardly be interpreted as anything other than the right and left n a s a l s, Table I, Fig. 7a, b. In each case, the posterior end is broken off transversely, and the anteriormost point is missing; the right is 54 cm long, the left, which is additionally somewhat crushed, is only 45 cm long. The complete elongated bones are narrow; they are nearly 8 cm wide at the posterior and near the anterior end; at the narrowest place, where they are thickest, which is somewhat in the middle, they are only 6.5 cm wide. The rather even median edge is narrow in the posterior third, then flattened to 3 cm wide, oblique to the dorsal surface, so that both nasals obviously abutted together here to form the skull roof. The lateral edge is approximately parallel to them, moderately sharp towards the back, then flattened oblique to the dorsal surface, and here similarly somewhat recessed, anterior to them they are again moderately sharp.

In the middle third of the anterior end there is an approximately 11 cm long process running towards the pointed anterior end. Above the midpoint, next to whose base is a long furrow, both of the processes ascend as an insertion into the premaxilla. Laterally from the process, the anterior part is somewhat concave as the posterior edge of the narrow nasal openings, with a small, anteriorly-rising corner of the lateral margins.

Below each nasal is a transverse, concave groove, narrowing somewhat towards its midlength, and having several small vascular cavities towards the rear and two longitudinal furrows in the middle third near the broken-off posterior end. The latter apparently served as the insertion for the prongs of the frontal, whose anterior margin however possess none, so that the middle parts of the elongate prefrontal must be accepted as the anterior prongs.

The dorsal surface of the nasal is in sharp contrast to the flat surface; it is peculiarly rough because of furrows and rounded bumps in the posterior half, and therefore in the middle part. Posteriorly, the dorsal surface is completely fairly even, over the narrowest point the highest bump (which is broken off on the right side) rises 3 cm tall above the median edge; next to it the dorsal surface is slightly arched, and anterior it is somewhat concave. The latter, along with the aforementioned shape of the roof and the bumps on the median edges, contribute to it such that the nasal region appears somewhat ridge-like here. Because the bumps probably all bore horny extensions, the whole snout was more humped dorsally, as is presumably the case in *Tyrannosaurus* (OSBORN, 1912, p. 8, Table 1); the ridge, however, is much fainter than in *Ceratosaurus nasicornis* and, in fact, in *Proceratosaurus bradleyi* (WOODWARD, 1910, p. 112). A dorsal horn was probably even placed here, on the parietal bumps.

Only the nasals of *Antrodemus* (GILMORE, 1920, p. 18, Fig. 9) are comparable in the same form. But these are only 36 cm long in the impressive specimen No. 4734, thus by far not as long; furthermore, they are smooth dorsally, split anteriorly on the midline, provided with a much longer anteriorly-rising process laterally, and extend on the lateral margin with a posteriorly-rising process for the lacrimal, and finally with an opening into the internal cavities anterior to it.

The left m a x i l l a, Table I, Fig. 6a, b is incomplete anteriorly, its attachment to the nasal and premaxilla as an ascending ramus is missing, and posteriorly a small process for its pointed posterior end is missing. The upper surface of the medial side is partially split away, in part intentionally prepared that way. Still, the major part is 47 cm long, the posterior end 21 cm; the former is about 19 cm tall anteriorly, and about 25 cm tall posteriorly. The complete maxilla was even over 70 cm long, compared to approximately 52 cm in the case of *Antrodemus valens*, which corresponds in longitudinal proportions with the nasals and speaks to the long appearance of the skull. On the right, at least two larger fragments of the somewhat weathered maxilla were unfortunately lost; a short anterior piece over 16 cm tall, and a 18 cm long piece of the middle section that is 15.5 cm tall anteriorly.

The only preserved piece on the left, the alveolar margin, is slightly convex ventrally; out from it, in the anterior part, runs a 1-3 cm long, small vascular canal* (GEFÄSSLÖCHER). The lateral side is not arched but even, in the posterior third it is smooth, but in the anterior two-thirds it is uneven, with approximately perpendicularly sculptured bulges, thereby being similar to the nasals. Close to the ventral margin, a rounded, strong edge begins quite posteriorly, which dorsally is aligned straight anteriorly, so that near the anterior end of the largest piece it lies 18 cm over the alveolar margin. It is highest on the posterior end, at which it rises laterally over 3 cm. Near the anterior end of the posterior piece, a larger vascular canal runs close to and under it out towards the posterior. Immediately over this lies the straight dorsal margin, which in this piece has a deep longitudinal furrow, probably for insertion of the jugal. The large piece is broken off evenly over the margin. At the posterior (middle) piece of the right maxilla, however, the apparently thicker upper margin is visible in the plane of the ledge with two longitudinal furrows, probably for the lacrimal. Finally, the anterior piece is broken off like the left one, evenly over the lateral edge, and here shows round cavities in the base of the ascending rami. Whether the maxilla bounded the ventral edge of the orbit, as is likely, how much of the antorbital fenestrae were within it, and whether and how it bounded the nasal opening, are, after all, not visible.

On the only posterior (middle) right piece observed, the dorsal surface here is entirely even, and 4 cm under its dorsal margin vascular cavities are observed that are 4 cm long and likely led into dental foramina for replacement teeth. The stone core of the anteriormost dental foramen is visibly broken; its dorsal margin lies close below the level of the lateral edge. It is also the same on the large left piece, where eight such stone cores were exposed below one another through weathering and preparation, and were prepared free by themselves in two cases. They are pearshaped, and somewhat laterally flattened with a pointed bottom, on which a little peg, the stone core of a vascular canal, is broken.

The dental alveoli are longitudinally oval, also like the normally deeper concave medial edge. 10 are observed in the largest piece, each approximately 4 cm long and 2 cm wide; the two most posterior are somewhat smaller. The bony septa are 0.8 to 1 cm long. The same can also be seen in the rest of the right piece. At the left posterior end, however, the remains of an alveolus is preserved in front, a last small one follows behind the first (3.5 cm long), 2.5 cm long and approximately 1.5 cm wide. There were probably not very many more than 12 functional teeth, which followed uniformly close to each other; only the most posterior were considerably smaller and stood farther away from one another.

Tyrannosaurus and *Gorgosaurus* from the uppermost Cretaceous are close in number of teeth, actually in addition in their case the arched lateral side of the maxilla is similarly rough (OSBORN, 1906, p. 284 and LAMBE, 1917, p. 13). However, the lateral edge – there as in other Theropoda as well – is not present, in their case the sculpturing is also missing. The maxilla of *Antrodemus valens* (GILMORE, 1920, Fig. 12) resembles the previous form only generally. It has a border (ledge) of the upper vascular canal on the outside, a longitudinal ledge on the upper part of the medial side, and ends posteriorly with a smaller point. It is considerably smaller, 36-38.8 cm long, and bears more teeth (16 to 18), and the case is similar with the lowermost Cretaceous *Ceratosaurus*. The maxilla of *Proceratosaurus bradleyi* is concave on the lateral side and has 18 teeth (WOODWARD, 1910, p. 112, Table 13), whereas the case of the Middle Jurassic *Megalosaurus bucklandi* and *Streptospondylus* may be similar to the previous form in the number of maxillary teeth (HUENE, 1926, pp. 47 and 54). A reduction in the number of teeth with a geologically younger age, as was proposed by GILMORE (1920, p. 145) for *Megalosaurus*, is however not discussed here.

Teeth.

The row of functional teeth in the maxilla has completely fallen out, but more replacement teeth can be seen, at least partially, in the large left maxilla and in the two right pieces. The apex of a replacement tooth projects in each alveolus, most of them somewhat approaching the posterior margin; [they are] at their widest on the left, 2 and 7 cm from the front, where they almost reach the upper surface, therefore into the anteriormost alveolus on the right, rear (middle) pieces. The apex lies much more deeply in it in the subsequent alveolus, and the impression of a tooth tip is situated in the anterior right piece. The most that can be seen of a replacement tooth is in the anteriormost alveolus in the rear (middle) right piece, Table I, Fig. 3, and a small crushed tooth root completely behind and about 6 teeth farther forward in the large left piece, Table I, Fig. 2.

All of these maxillary teeth show the same structure: they are straight, strongly laterally flattened, with similar, very bulky arched lateral and medial sides, stronger arches in the middle of the teeth, and sharpened, somewhat convex, fine serrations on the anterior and posterior edges. The teeth, whose perpendicular cross-section is approximately spindle-shaped, are therefore hardly distinguishable at the anterior and posterior, lateral and medial sides, and are rather more similar to those of the selachian *Carcharodon* than to the continually recurved and thinning teeth of the Megalosauridae. In the upper half of the tooth there are 18-20 serrations on a 1 cm length of margin. The serrations on the better preserved tooth germ, Table I, Fig. 2, which is 6.8 cm tall and 3.5 cm wide, and whose lower enamel edge is unfortunately not visible, can be followed quite far down on the posterior edge, although only 4.5 cm under the apex anteriorly. The enamel is finely perpendicularly wrinkled (shown only by means of magnification), which are raised to the right on visible replacement teeth, therefore slightly bulging towards the anterior edge; each is about half the width of a serration, and they are approximately 2 serrations apart and lean somewhat posteriorly. The tooth is 1.7 cm long and 0.8 cm thick at 1.3 cm below its apex, and therefore approximately twice as long as thick, Table I, Fig. 3.

Besides this, even small pieces of teeth secured from their positions are present, by which it is naturally not known whether they come from the maxilla. They are essentially similar. On one piece of the margin, however, the aforementioned bulges are considerably more distinct than on the replacement teeth, but here they are also completely obscured almost 4 cm from the margin. Only the completely preserved piece of tooth is remarkable, whose anterior margin is almost 6 cm tall, Table I, Fig. 1. It is 1.7 cm long and 0.9 cm thick at 1.5 cm below the apex; the cross-section, the arching of the lateral and medial sides, also the very fine enamel wrinkles and the slightly transverse bulge against the anterior margin, whose serrations are preserved, are as in the already described teeth. The anterior margin is however somewhat convex, it nevertheless arches posteriorly against the apex, and the posterior margin is somewhat concave, in contrast to the previous, so that this tooth is similar to the weakly recurved megalosaurid teeth. On the anterior edge more than 21 serrations are present on a 1 cm long edge, however, the serrations become finer and continue 5.8 cm under the apex, which shows wear-marks, just as in the uppermost part of the anterior margin. Under that, the anterior margin is rounded without an edge. On a middle piece of the posterior margin, the serrations are as fine as the anterior lower part; here there are 24 serrations on a 1 cm edge.

Up to the more pronounced convexity of the anterior edge, and the smaller basal length, this tooth corresponds completely with the smaller teeth from the Albian of Timimoun (Algerian Sahara), which DÉPERET and SAVORNIN (1927, Table 12, Fig. 1, 1a) made the type of *Dryptosaurus saharicus*. Although unfortunately no measurements of the serrations, and above all no drawing of the cross-section, were given, and definitions of single teeth of the theropod alone were established, the special correspondence seems justified in this case. Therefore, it is a matter of finding approximately similar aged beds in the similar geographical region of North Africa.

The teeth of *Megalosaurus bucklandi, Proceratosaurus bradleyi, Antrodemus valens, Ceratosaurus nasicornis, Tyrannosaurus rex, Dryptosaurus incrassatus*, and *Gorgosaurus libratus* are much slimmer and always distinctly recurved, just as those of *Albertosaurus periculosus* RIABININ (p. 130, Table 1, Fig. 2, 2a, 2b) and *Allosaurus medius* MARSH (LULL, 1911, p. 186, Table 14, Fig. 1, 2). This is also the case with the lower teeth of *Dryptosaurus* (*Laelaps*) *aquilunguis* (COPE, 1869, p. 101, Table 10, Fig. 5), which is therefore of importance because DÉPERET and SAVORNIN (1927, pp. 262-264) added their new type to this genus. In the *Erectopus superbus* (SAUVAGE) from the Gault of France, which they likewise place in that class, the smaller known teeth are indeed slightly recurved to the right (SAUVAGE, 1882, Table 20, Fig. 3-5), but are similar to the Megalosauridae in their slenderness.

Such bilateral symmetry, and neither medially nor posteriorly curving teeth, as in the maxilla of the present form I do not find described elsewhere for the Theropoda. However, they nevertheless occur in the close-standing *saharicus* type. DÉPERET and SAVORNIN (*loc. cit.*) mentioned *Megalosaurus crenatissimus* DÉPERET from the Upper Cretaceous of Madagascar, where the teeth are similarly wide. However, they point out the distinctly recurved apex, and in the type (DÉPERET , 1896, p. 188, Table 6, Fig. 4, 5) and, in addition, less in the case of a tooth from THÉVENIN (1907, p. 14, Table 1, Fig. 17); the [teeth] are more arched in cross-section, and the bulge is closer to the anterior margin. Nearby, therefore, stands the megalosaurid tooth Type B of JANENSCH (1925, pp. 91-92, Table 10, Fig. 8) from the Upper Saurian Bed of Tendaguru in German East Africa, whose finer serrations can be linked to its smaller size. Nevertheless, as I also saw in the type, it is a little more recurved, and a little more bulged medially, and its more pronounced arch lies somewhat anterior to the middle of the tooth, also it has a smaller width. Finally, an entirely particular similarity also in the width are the teeth from the "Senonian" Phosphate of the Arabian desert of Southern Egypt, that GEMELLARO (1921, pp. 347-49) counted among *Megalosaurus crenatissimus*, which, however, according to its cross-section more likely belongs here, particularly that represented in Fig. 13. Finally, there is a megalosaurid tooth crown from the Arialur Beds of southern India, which LYDEKKER (1879, p. 26, Table 6, Fig. 6, 7) described, and is similar in its width and small recurvature, but is distinctly different in the cross-sectional thickness of its anterior margin. Nevertheless, it is still remarkable that the most similar tooth forms were found in the Cretaceous of North and East Africa, Madagascar, and southern India, in areas which even today hold the nearest relationships in the animal realm.

However, it must be emphasized that single theropod teeth can be safely defined only in particular cases. In addition to that are those described by JANENSCH (1925, p. 79 *ff*.) in which he very thankfully increased the worth of their assignablility, whereby he only did not emphasize the importance of the cross-section; most do not allow nearly enough description and illustration, for example, too frequently without upper and lower cross-sections. It is confirmed that the serrations on one and the same tooth can be differentiated on its strong points (JANENSCH , 1925, p. 92), so that the tooth form and size in false teeth can change considerably even according to the position; for example, in *Spinosaurus* (STROMER, 1915, Table 1, Fig. 5-10), *Gorgosaurus* (LAMBE, 1917, pp. 16-20), and *Deinodon* (Matthew and Brown, 1922, pp. 282-283); and above all, so that on the other hand, teeth of such differing families as *Antrodemus* and *Ceratosaurus* can hardly be distinguished (GILMORE, 1920, p. 30, pp. 92-3).

DÉPERET and SAVORNIN (1927) made now-valuable remarks on it, mainly that the marginal serrations of the anterior margin in geologically old Megalosauridae are confined to the uppermost part of the tooth, in younger forms they reach deeper, and by most of the middle to Upper Cretaceous, they reach completely to the base. Unfortunately, they completely ignored the previous work of JANENSCH, and it is indicated there that the piece of tooth described by me shows anterior serrations running farther down.

Above all, it is indeed emphasized that not only in the Lower Cretaceous *Allosaurus medius* MARSH (LULL, 1911, p. 183, Table 14, Fig. 1, 2) from Maryland and the taxon already named by DÉPERET and SAVORNIN, *Megalosaurus*? *panonniensis* Seeley (1881, p. 670, Table 27, Fig. 21-23) from the Senonian of the Viennese Neustadt, but also in relatively many uppermost Cretaceous theropods the anterior margin serrations do not extend downward very far, as in *Megalosaurus hungaricus* NOPSCA (1902, pp. 11-16, Fig. 1-6) from the Danian Siebenbürgens, *Albertosaurus periculosus* Riabinin (1930, pp. 44-47, Fig. 2, 2a, 2b) from the northeast Asian Amurland, *Gorgosaurus libratus* LAMBE (1917, pp. 17-18), and *Albertosaurus sarcophagus* OSBORN (LAMBE, 1904, p. 17, Table 6, Fig. 9-14)[1] from southern Canada, and in the most likely similarity *Genyodectes serus* WOODWARD (1901, pp. 180/1, Table 18, Fig. 3, Table 19) from northern Patagonia. According to the last mentioned both American species, one can no longer consider a relic, just as also by *M. hungaricus*, although according to NOPSCA (1923, pp. 107-110), other reptiles of Siebenbürgens, an Upper Cretaceous island, were more primitive than contemporaneous animals of other areas, and one cannot consider eliminating other species as not belonging to the Megalosauridae from their stage of development. However, before the systematics of the large theropods is somewhat clarified, the fact must be emphasized that just the geologically youngest families have the feature mentioned by DÉPERET and

[1] On the naming of these remains see PARKS (1928, pp. 3-7)!

SAVORNIN as well as the oldest. It is therefore certainly of value, although regardless of others, just as the cross-section, although insufficient for far-reaching conclusions.

Vertebrae.

Sutures of the neural arch are not observed in the vertebrae, evidence that the skeletal remains belonged to a grown individual. There are three cervical vertebrae, unfortunately all are weathered and incompletely preserved. The apparently short centrum of the a x i s a, Table I, Fig. 8, whose posterior side is weathered, is 8 cm tall anteriorly and about 11 cm wide. Its somewhat concave anterior surface carries the broken-off dens above, 3 cm tall anteriorly and 4.5 cm wide. Halfway up the side is found the almost laterally running parapophysis with a concave articular surface. The neural arch rises sharply posteriorly, so that the ventral margin of the postzygapophysis lies 7.5 cm over the dorsal surface of the centrum. The spinous process arises along the entire length of the arch, does not rise up or does so only slightly anteriorly, and its anterior edge rises posteriorly parallel with the roof dorsally, so that the spinous process finally builds only an approximately 3 cm tall rim above it. Its posterior side ends just as in the other continuations, is broken up to a part of the right prezygapophysis. This is very small and placed very deeply; it projects only somewhat anteriorly and has a surface that is seen as an articular surface at the top. The postzygapophyses are considerably larger and placed much higher.

The axis of *Tyrannosaurus* (OSBORN, 1906, Fig. 3) seems very similar, also that of *Antrodemus*, concerning the spinous process. But here as in *Ceratosaurus*, in whose remains the neural arch and spinous process rise a little posteriorly, the spinous process has a projecting corner, and the centrum is considerably more elongated (GILMORE, 1920, Fig. 17, Table 19, Fig. 6-10). Also in the case of *Spinosaurus aegyptiacus* (STROMER, 1915, pp. 12-14, Table 2, Fig. 1a, b) the centrum is more elongated, and in addition more oval in cross-section, and the arch rises a little more steeply.

C e r v i c a l v e r t e b r a b, Table 1, Fig. 9, belongs to the anterior region according to the deep position and shape of its parapophysis and shape. Its centrum is up to 10 cm long, 6.8 cm tall anteriorly and 8 cm wide. The pronounced opisthocoelous centrum is even somewhat oval [in cross-section] and a little elongated. Ventrally there is a central keel that thickens posteriorly; laterally, it leads into a pleurocentral groove with a foramen in the interior. The neural canal is only 1.5 cm tall and 2.7 cm wide anteriorly, most likely because of moderate widening. The dorsal surfaces of the arch with the postzygapophyses and spinous process is broken off just at the end of the diapophysis. The wide, short prezygapophyses projects anteriorly somewhat ventrolaterally and bears flattened, approximately circular articular surfaces, which dorsally seem to be somewhat medial and slightly anterior. Under each, the sharp anterior margin of the flat diapophysis goes ventrally, moderately laterally and posteriorly. Between it and the anterior margin, the neural arch is a deep groove. Laterally below and anterior to the centrum, the thick parapophysis towers on either side with highly oval, concave articular surfaces scarcely 1 cm wide.

A further cervical vertebra c is of such a type; pressed flat anteriorly and posteriorly so that the circumference is even doubled, seeming as large as vertebrae a and b. It cannot here be firmly established distinctly as the opisthocoely and the pleurocentral groove with foramen.

The middle 4 to 6 cervical vertebrae of *Antrodemus* (GILMORE, 1920, Fig. 18, 19) are undoubtedly as large as vertebra b, but somewhat longer and not as wide, and its neural canal is taller than wide. The middle cervical vertebrae of *Tyrannosaurus* (OSBORN, 1906, p. 288, Fig. 3) are also very short, but less opisthocoelous; for *Gorgosaurus*, unfortunately these cervical vertebrae are almost completely weathered (LAMBE, 1917, p. 22), however, it can be established that these likewise were short. In the case of *Spinosaurus*, however, they are distinctly elongated (STROMER, 1915, p. 13, Table 2, Fig. 2).

In the l a s t v e r t e b r a d, Table I, Fig. 10a, b, the spinous process and the diapophysis are excellently preserved up to the postzygapophyses. It is platycoelous, at the posteroventral end it has starting places for chevrons, and thus an anterior caudal vertebra. Its centrum is 14.5 cm long, anteriorly 12.2 cm tall and wide, therefore greatly elongated. On either side of its bottom, strong diaphyses, which are laterally somewhat convex and somewhat concave longitudinally, conduct a foramen into the pleurocoelous foramen. The vertebral foramen is 2.6 cm tall and 2.9 cm wide anteriorly, and proportionally wide. This and the size of the vertebra speak for a very strong tail. The moderate neural arch begins along the entire length of the centrum; its roof rises to nothing posteriorly. The short, broad prezygapophyses tower above and somewhat laterally in front, and have completely concave, approximately circular articular surfaces, which seem to lean medially at the top. The only partially preserved postzygapophyses are allowed to have a corresponding disposition. Above both the pre- and postzygapophyses run a narrow supports that converge at the spinous process. From there its preserved height is 8 cm, apparently weakly posteriorly-inclined surface. Both anterior and posterior to its base, a deep, medial notch borders it through the supports. A foramen leads into the anterior part laterally, behind the prezygapophyses. It is somewhat taller than the funnel-shaped groove on the anterior caudal vertebra *n*, which I have described for *Spinosaurus aegyptiacus* (STROMER, 1915, p. 22, Table 1, Fig. 1b), which, however, does not belong to that skeleton because it is much too large. A horizontal sharp edge immediately above this foramen passes over the diapophysis into the anterior edge, which begins in the middle of the roof. It is dorsoventrally flat, not thick posteriorly, has no ventral support or edge, and apparently towers somewhat posteriorly.

The vertebra is much longer and somewhat smaller than the aforementioned vertebra *n* and distinguishes itself from it also clearly through the notches in the spinous process. There, it is approximately as large as the anteriormost sacral vertebra of *Spinosaurus aegyptiacus* (STROMER, 1915, p. 20, Table 1, Fig. 16a, b), but it is wider; that vertebra belonging to the sacrum must, however, have been longer than these. *Gorgosaurus* has short anterior caudal vertebrae, whose centra are as tall as long (LAMBE, 1917, p. 28, Fig. 14B); that of *Albertosaurus* appears to be even taller than long (PARKS, 1928, p. 9, Table 1). Likewise, *Antrodemus* has short anterior caudal vertebrae (GILMORE, 1920, pp. 45-6), apparently also *Tyrannosaurus* (OSBORN, 1906, Table 39), and likewise *Megalosaurus* (v. HUENE, 1926a, p. 49, Fig. 4). That of *Ceratosaurus*, however, is likewise lengthened; it has however a ventral furrow, and above all it is missing the peculiar pleurocoelous foramen (GILMORE, 1920, pp. 98-9, Table 21, Fig. 1, Table 22, Text-Figure 57). This is distinguished also from the anteriormost caudal vertebrae of *Dryptosaurus* (*Laelaps*) *aquilunguis* (Cope, 1869, pp. 101-2, Table 8, Fig. 2, 3), which are likewise lengthened, but distinctly wider anteriorly than tall. Upright, the well-preserved caudal vertebra d shows particularly that sharply distinguish it from all other similar vertebrae.

Of the r i b s, only the upper end of a large, two-headed rib remains, which is somewhat flattened out, but was surely originally already flattened.

Of the c h e v r o n s there is a 7.5 cm wide upper end and a piece of a shaft that probably belonged to it, which is preserved only up to 13 cm from the point of bifurcation, and is only slightly posteriorly curved; and a rather complete chevron up to the lower end, its shaft somewhat asymmetrically swung to the right, Table I, Fig. 11a–c. Also, this one is 15 cm long and leans slightly posteriorly. At the top, this piece is only 5 cm wide. The anterior convex edge, which is a little sunken in the middle and to whose shaft axis there is an approximately perpendicular dorsal articular surface at the outgoing vertebra, there stands through a rounded, convex, very slightly anterior edge of that almost perpendicular to it; many small surfaces are bounded for the subsequent vertebral centra. Firstly, the width fits at the largest piece, but the form does not fit the above-described vertebra d. In either case, it belongs to the chevrons of the anteriormost caudal vertebrae.

It is characteristic that the haemal canal, as in *Poikilopleuron* (Deslongchamps, 1838, p. 80, Table 2, Fig. 10), *Antrodemus* (GILMORE, 1920, pp. 48, Fig 32) and *Ceratosaurus* (*loc. cit*., p. 101), in contrast to that of *Gorgosaurus* (LAMBE, 1917, p. 31, Fig. 19) and *Albertosaurus* (PARKS, 1928, p. 10), is bridged over and duplicated over as high as it is wide; further, that the upper end is a little wider than that of *Antrodemus*, but in this case, because it possesses slightly projecting corners on either side of the haemal canal, and finally, that the shaft below is somewhat widened in sagittally, in contrast to *Antrodemus* and *Poikilopleuron*, as in the middle chevrons of *Tyrannosaurus* (OSBORN, 1917, Table 27), where above, however, there are also posteriorly-towering corners.

Hind Limb.

The left i s c h i u m, Table I, Fig. 12, is somewhat damaged above at the end of the pubis and ischium, just as its margin which runs to the obturator process is also damaged, and almost the whole shaft is broken off. Dorsally, it is almost 34 cm long, the acetabular margin is only about 14 cm long in a straight line; at the pubic end it is up to 10.5 cm thick, and at the iliac end, 9.5 cm thick. At the top, the distance from the former to the upper margin of the obturator process measures about 27 cm; the shaft at the smallest place above the midline measures more than 9 cm, under the midline it is more than 7.5 cm, and transversely only 3.5 cm. The latter measurement corresponds with that of *Antrodemus valens* No. 4734 (GILMORE, 1920, p. 68), but there the dorsal length is only 26 cm, above all because there the pubic end is not extended ventrally towards the front, whereas here the pubic surface is about 13 cm tall. Also, the differences are otherwise conspicuous from [*Antrodemus*] in the total picture of the ischium (*loc. cit*., Table 12, 13). Above, there is a deep groove in the iliac end as in *Gorgosaurus* (LAMBE, 1917, p. 62), the pubic end is not rounded in front but has a strong, laterally flat anteroventral process that bulges laterally, and increases up to 12 cm in height medially at its concave contact with the pubis. However, it is peculiar that the acetabular edge does not stand approximately perpendicular to the long axis of the shaft as in *Antrodemus* and *Ceratosaurus* (GILMORE, 1920, Table 23), but rather at a very obtuse angle, and that this axis does not run on its middle, but on the anterior end; therefore, that the shaft obviously towers in an unusual way more posteriorly than ventrally. The ischium of *Albertosaurus* (PARKS, 1928, Text-Fig. 10) bridges over the difference in this respect.

The medial side of the ischium is somewhat concave dorsally, however it becomes flat against the obturator process, and bulges moderately curved at the shaft. The lateral side is dorsally arched anteriorly and posteriorly, and is somewhat concave in between; it is slightly concave in the width of the obturator process and at the shaft, and here it is angularly bounded posteriorly. The 4.5 cm thick posterior margin develops a wide concavity from the iliac end, whereby a longitudinal oval rougehened area is present 13 cm under its dorsal end, similar to *Gorgosaurus* and *Albertosaurus* (PARKS, 1928, p. 23). It is, according to GREGORY and CAMP (1918, p. 490, Table 46D), probably the origination site for the M. flexor tibialis medialis (= semimembranosus).

The entire anterior margin is much thinner and was, in fact, sharp except at the obturator process. Apparently, it developed a wide concavity from the pubic end up to the process. Underneath it there is a quite small notch as in *Antrodemus*, and from there on like there, a considerably straight sharp edge, from which it is not possible to see whether [the notch] is curved away somewhat on the medial side.

Ceratosaurus differs even more than *Antrodemus* except in the shaft direction by the absence of the obturator process and the unusual height of its pubic end. *Tyrannosaurus* (OSBORN, 1906, p. 292, Fig. 7) also has a slightly concave posterior margin, a projection on it at the place of the roughness, and a strongly projecting obturator process. The latter is also true for *Gorgosaurus* (LAMBE, 1917, Fig. 58) and *Albertosaurus* (PARKS, 1928, Text-Fig. 10, p. 23), where the posterior margin is also slightly concave, but here the shaft direction is nevertheless somewhat similar and the contact with the pubis is tall; also, the iliac surface deepens and the muscle-roughness at the posterior margin is present.

The right and left p u b e s are incomplete dorsally and ventrally though weathering, the top of the right one considerably more; ventrally, a little bit less than the left, and for both, the thin surface which binds them together is weathered. The left, Table 1, Fig. 13a–c, is even over 80 cm long and must have been over 1 m long. Because of this, and the deviation of the form from the normal case of Theropoda, it was not easy to orient both pieces correctly, and comparable measurements are made difficult. The shaft diameters above the ventral spread are on the left 6.5 cm transversely and 7.5 cm anteroposteriorly, and more than 6.6 cm with regards to over {?} 20 cm. Right under, the shaft diameter is more than 16 cm anteroposteriorly, because even here the beginning of the widening for the foot is present. In the middle of its length, the shaft is only slightly flattened. It is fairly evenly curved concave somewhat anteriorly. Its anterior margin is completely rounded, only a little less in the wider dorsal part. The posterior margin is somewhat sharp-edged dorsally and ventrally, but somewhat flat at midlength. Its dorsal margin is bent against the bottom to bind both bones together gradually inwards, in order to pass over into the obviously very thin lamellae. It could have been scarcely 40 cm long, because this symphysis is also missing at the ventral widening. In the transverse direction, the pubis, as far as is preserved, is slightly bent, also conspicuously in the dorsal part, so that both bones actually did not build a wide U-shape together dorsally.

Underneath, the bones become flattened more laterally, particularly towards the back, whereby the posterior margin bends itself suddenly posteriorly. The thus-developed widening is outwardly completely slightly concave; inwards, it is somewhat bulged, and so smooth that the apparent little foot could have had, at best, a symphyseal connection ventrally. Dorsally, the widening is inwardly completely concave; laterally, it is bulged also as the dorsal surface. Its posteromedial margin is bent dorsally, to begin posteriorly, as here, the strong dorsal widening at the acetabulum, which unfortunately is missing.

Indeed, the pubes have the non-merging above the foot and the concave binding of the anterior margin in common with those of *Antrodemus* (GILMORE, 1920, Table 11), but they must have been easily distinguished particularly in the dorsal parts, because there above the symphysis the cross-section of the shaft is oval (GILMORE, p. 66). Here *Ceratosaurus* is more similar (GILMORE, 1920, pp. 107-8, Table 21, Fig. 2 and Table 23), in which the bones diverge a little more V-shaped instead of U-shaped, and the posterior margin bends posteriorly near above the symphysis. Most likely there was a pubic foramen present even in the piece in question just as in *Ceratosaurus*; a medial bending of the widening is indeed not implied and otherwise distinctly distinguishes the shaft. In *Tyrannosaurus* (OSBORN, 1906, p. 293, Fig. 7) as well as in *Gorgosaurus* (LAMBE, 1917, p. 61, Fig. 38) and *Albertosaurus* (PARKS, 1928, Text-Fig. 10), the pubic foramen is missing, and the bones narrow promptly under the dorsal widening, in contrast to the bone in question, as is often the rule. The shaft cross-section is even just as longitudinally oval (5.2, 6.6 cm) above the symphysis in *Gorgosaurus*. In the case of the latter three named species, however, the pubis is anteriorly not as similarly concave, and overall its shaft is not as bent and the foot is very large.

From the right, Table I, Fig. 14b, as well as the left f e m u r, Table I, Fig. 14a, the upper end is well-preserved up to the damaged part, particularly at the left head, and up to the right greater trochanter; the diaphysis, however, was completely crushed and, because of poor packing, was broken into so many little pieces by transport that, in spite of long efforts, I could only put it together very incompletely. The lower end is again not crushed, but is somewhat weathered underneath and at the back at the condyle.

The measurements in cm are:

	overall length	greatest diameter head	greatest diameter below	med. cond. thickness	midshaft sagittal	midshaft transv.
1922 X 46	126	ca. 28	ca. 26	ca. 20	—	—
Antrodemus No. 4734	85	19.5	18.2	—	—	9.5?
Ceratosaurus No. 4735	62	15	13.5	—	—	5.2
Tyrannosaurus OSBORN 1906	130	over 20	34	—	—	18?
Gorgosaurus LAMBE 1917, Type	104	—	—	—	13.6	—
Laelaps COPE 1869	80	—	16	—	—	—

The femur is therefore over double the length of *Ceratosaurus nasicornis* and almost as large as *Tyrannosaurus rex*, therefore also considerably greater than in *Antrodemus valens*. In contrast to those names, the medial part of the head towers above a little higher than the lateral part, so that is does not project horizontally medially as in Antrodemus, but rather somewhat obliquely dorsally, and so that it is here particularly bulged dorsally. Therefore, the impression is intensified, as to be only this part of the head and to correspond with the lateral part of the greater trochanter, as it is often taken for in the literature. GREGORY (1929, p. 528 *ff*., Table 48), however, has a sound interpretation that the complete, strongly oval upper end of the femur corresponds solely to the head in reptiles. At the medial part there is a perpendicular furrow (for the ligamentum teres?) as in the rear of *Antrodemus* (GILMORE, 1920, Table 14, Fig. 3), and is underneath anteriorly, an edge passes laterally somewhat below, in order to continue on the concave anterior side somewhat under the deep notch between the head and the greater trochanter. This was often described as the lesser trochanter, for example by GILMORE (1920, p. 69), which indeed lies medially at the back, therefore directly opposing, and is absent in typical forms of birds and dinosaurs. OWEN (1857, p. 17), in contrast, had already described the greater trochanter. In contrast to *Ceratosaurus*, here it is impressive as in *Tyrannosaurus, Gorgosaurus*, and *Antrodemus*; a laterally bulging, perpendicularly striated, medially concave plate that indeed here projected only as far as under the level of those anteromedial edges because of the high position of the head; therefore it is less than [in *Ceratosaurus*]. One peculiarity is an approximately right-angled corner that projects anterolaterally from the middle of its anterior and lateral edges.

Almost 50 cm under the dorsal edge of the head lies on the medial side the only preserved fourth trochanter on the left, which according to GREGORY (1918, p. 528 *ff*.) corresponds to the lesser trochanter of mammals[1]. It is here a short ledge, which is somewhat more pronounced than in *Antrodemus*, and lies somewhat higher.

The question of the shaft curvature, cross-section, and position of the lower widening to the top unfortunately cannot be established; indeed, the bending seems to have been proportional. Distally, however, the described features are seen. Anteriorly, the middle furrow is narrow and

[1] Concerning the development in the case of the swimming birds see LAMBRECHT 1929, S. 1265/6!

deep; laterally from it the anterior side goes over rounded into the perpendicular, striated, likewise slightly bulging lateral side. Medially, however, the anterior side is very strongly convex and supplied with an approximately 30 cm long proximally-trending ridge that corresponds to the origination site of the muscle in *Antrodemus* (GILMORE, 1920, Table 21). Already, this is clearly distinguished from the femur of *Megalosaurus bucklandi* (OWEN, 1857, Table 8), *Erectopus superbus* SAUVAGE (1882, Table 29, Fig. 1b), *Streptospondylus cuvieri* (v. HUENE, 1926a, Fig. 32b), and *Gorgosaurus* (LAMBE, 1917, Fig. 40). In the case of *Ceratosaurus nasicornis*, the distal end is unfortunately too damaged to establish the type. One femur, in question as to whether it belongs to this species, from the Upper Saurian Bed of Tendaguru, possesses this edge (JANENSCH, 1925, pp. 69-70, Table 5, Fig. 1), however it is narrow distally and the middle furrow is completely flat and wide.

The medial side is flat, in the case of *Laelaps* it is concave (Cope, 1869, p. 104). The medial condyle appears to project a little deeper than the fibular condyle. It is not wide posteriorly, rather it is very convex and reaches proximally about 16 cm. The intercondylar fossa is deep and broad posteriorly. The lateral condyle, only damaged on the left, is parallel to the medial condyle and reaches only 15 cm above the distal end. Laterally from it, there is a 5 cm wide surface passing posteriorly, which is distinguished from the lateral side of the femur by a rounded right angle. It is obviously corresponds to the articular surface for the fibula, as it is named in birds, although the posteriorly-projecting lateral condyle intervenes there between the tibia and fibula.

In the case of the aforementioned femur from Tendaguru, the articular surface for the fibula is indeed formed similarly, but the lateral condyle reaches up higher on the back, and stands oblique to the long axis of the femur as in *Ceratosaurus* (GILMORE, 1920, Text-Fig. 64C), and the medial condyle is wider in back. The other femur from Tendaguru (JANENSCH, 1925, Table 5, Fig. 3) is more similar underneath at the posterior side of the femur, but the articular surface for the fibula is narrower and placed somewhat laterally. This is even more the case in the femur of *Antrodemus* (GILMORE, 1920, Table 14, Fig. 1 and 7), where however both condyles of the existing femur are similar in breadth and position. The femora of *Gorgosaurus* and *Albertosaurus* (LAMBE, 1917 and PARKS, 1928) seem unfortunately too poorly preserved, particularly at the distal end, for a comparison, and that of *Tyrannosaurus* (OSBORN, 1906, p. 293, Fig. 9a, b; 1917, Fig. 21a) is not completely described. It seems to be considerably similar down posteriorly, but the lateral condyle is substantially higher up than the medial. Anteriorly, the median groove is apparently not as narrow and deep. The femora of *Megalosaurus bucklandi* (OWEN, 1857, Tables 7, 8) and *Streptospondylus cuvieri* (v. HUENE, 1926a, p. 63, Fig. 32a, b) from Dogger, England are considerably more clearly distinguished because on them the anterior groove is completely flat and wide, there is no anterior edge, the medial condyle is wider posteriorly, and the articular surface for the fibula is strongly angled laterally. Finally, the femur of *Erectopus insignis* (SAUVAGE, 1882, Table 29, Fig. 1, 1a, 1b) from the Gault of France is similar posteriorly, distally, on the right, nevertheless here, anteriorly, the clear differences above are already mentioned.

In any case, therefore, the femur shows particulars at the proximal as well as the distal end that allow it to be easily distinguished from all those compared. A tibia belonging to it is unfortunately not present, however a little can be said about its probable length on the basis of the following tables:

length in cm of:	femur	tibia	fibula	
Megalosaurus bucklandi	81	65	—	(OWEN, 1857, pp. 17-18)
	1.23 :	1		

Streptospondylus cuvieri	1.05 :	1 :	—	(NOPSCA, 1906, p. 78)
Antrodemus valens	85	69	62.3	(GILMORE, 1920, No. 4734)
	1.23 :	1 :	0.9	
Ceratosaurus nasicornis	62	55.5	50.2	(GILMORE, 1920, No. 4735)
	1.11 :	1 :	0.9	
Tyrannosaurus rex	130	114	—	(OSBORN, 1906, p. 294)
	1.14 :	1		
Gorgosaurus libratus	104	95	88.3	(LAMBE, 1917, p. 68)
	1.09 :	1 :	0.92	
Albertosaurus arctunguis	102	98	87.5	(PARKS, 1928, pp. 38-39)
	1.04 :	1 :	0.89	
1922 X 46	126	—	88	
	1.26 :	1? :	0.88	

According to this table, the tibia of the large theropod[1] is almost up to 1/3 shorter than the femur and approximately 1/10 longer than the fibula. Because we add it here among the other 1 m lengths, the meaning of the numbers inserts itself excellently.

A left f i b u l a, Table 1, Fig. 15a–c, finally, is well-preserved up to a slightly damaged area at the proximal end, and it is a little crushed. The measurements in cm are:

	greatest length	greatest proximal thickness	greatest proximal width	mid thickness	shaft width	distal thickness	end width
1922 X 46	88	18	7.5	5.5	3.3	5.8	10.9
Antrodemus (GILMORE, 1920, p.71, Fig. 48, 49)	62.3	14.5	—	—	3.3	4.9	5.9
Ceratosaurus (GILMORE, 1920, p. 111, Fig. 65)	50.2	12.5	—	—	2.8	—	5.3
Gorgosaurus (LAMBE, 1917, p. 68, Fig. 42, 43)	88.3	18	—	4.7	3.7	5	—
Albertosaurus (PARKS, 1928, p. 39, Fig. 14)	87.5	19.5	—	—	—	5.5	—

The fibula corresponds well with *Gorgosaurus libratus* and *Albertosaurus arctunguis* in size and proportions, as far as the latter can be established. In the case of both, however, the femur is considerably shorter. The starting point at the proximal end is kidney-shaped in outline, evenly rounded anteriorly and at the slightly injured posterior end, although it runs posteriorly at a pointed angle as in *Erectopus superbus* (SAUVAGE, 1882, p. 17, Table 29, Fig. 2), *Antrodemus valens* (GILMORE, 1920), and *Gorgosaurus libratus* (LAMBE, 1917); and is laterally more

[1] In most cases such as *Coelurosauria*, indeed, put together almost always without genuine definition of this group; in smaller Dinosauria, the proportion of the femur to the tibia is as great as in the previous form only in the Lower Cretaceous *Ornitholestes hermanni* OSBORN; in all others, where I could ascertain (*Compsognathus longipes* A. WAGNER, *Elaphrosaurus bambergi* JANENSCH, *Struthiomimus altus* OSBORN, and *S. brevitertius* PARKS) it is completely reversed, the femur being shorter than the tibia (0.8–0.88:1), as in birds and leaping mammals.

flattened as in *Albertosaurus arctunguis* (PARKS, 1928, Fig. 13). The anterior edge projects distinctly, while the posterior edge projects slightly backwards; in the case of *Antrodemus, Ceratosaurus* (GILMORE, 1920), and especially *Albertosaurus*, it is completely reversed. As in *Antrodemus* and *Albertosaurus*, in contrast to *Ceratosaurus*, the bone narrows rapidly in lateral view to a very narrow shaft, which is however still narrower in *Gorgosaurus*.

The lateral side is bulged, the medial side, however, is flat only completely underneath and is one piece wide in the upper third; otherwise, particularly concave, as that the middle cross-section is half moon-shaped, which distinguishes it from *Antrodemus, Gorgosaurus*, and *Albertosaurus*. At the anterior margin, near the medial part of the proximal end, there is a projecting, unfortunately damaged, edge; and there is a longitudinally oval, rough place almost 30 cm from the proximal end, therefore at the lower end of the upper third. Both are not seen in the form of *Antrodemus*; in *Ceratosaurus*, however, the edge seems to be implied (GILMORE, 1920, Fig. 65A), and instead of the roughness, a blunt-angled edge seems to be present (*loc. cit*., Fig. 65B). In the case of *Gorgosaurus* (LAMBE, 1917, Fig. 42A), and *Albertosaurus* (PARKS, 1928, Fig. 14), in their place there is a rough edge. Under that, the anterior margin is sharp-edged up to 11 cm above the distal end. Here, a furrow crosses it, running from the proximal rear to the distal front, below which the anterior margin becomes widely rounded. Up to this furrow, the lateral edge of the ascending process of the astragalus is appressed against the flat medial side, in contrast to *Albertosaurus*, which can be seen in Fig. 48A of *Antrodemus* (GILMORE, 1920). The posterior end of the shaft is for the most part rounded, but even sharp completely underneath. The distal end starting underneath widens obliquely at the top, namely, stronger from the anteromedial to the posterolateral than in similar species, [the distal end is] particularly wider than *Albertosaurus*. Outwards anteriorly it is thick, posteriorly it is thin.

Even the fibula accordingly shows a number of particulars, not only at the articular ends, but also at the shaft.

After all these things, it is a matter of a theropod form that is distinctly different from the previously known species, which I name ***Carcharodontosaurus*** according to the gross similarity with the teeth of *Carcharodon*. These, however, as explained above on p. 8, even the teeth belonging to that, which are hardly distinguishable from those of *Dryptosaurus saharicus* DÉPERET and SAVORNIN (1927), must carry this name. The peculiarity of the form could actually justify the establishment of the family *Carcharodontosauridae*. I want to obstruct, however, the detailed ordering of the shaft-relationships as well as of *Spinosaurus* as the existing species, on the summary representation of the *Dinosauria* of the Baharîje Beds. Here a diagnosis suffices that is bases exclusively on the collective remains of the described individual:

Carcharodontosaurus saharicus (DÉPERET and SAVORNIN). Middle Cretaceous of North Africa. As large as *Gorgosaurus libratus* LAMBE. Skull: Parietal coossified with the frontal, forming a quadrilateral hump firstly above. Long facial part of skull, particularly the nasals. This roof ridge is pushed together anteriorly with a humped dorsal surface. The maxilla with perpendicular bulges and strong longitudinal edges gradually rises anteriorly. Braincase similar to that of *Ceratosaurus*, only the olfactory bulbs diverge more sharply, and the complete brain cavity is narrower and more strongly bulged. Dentition: About 12 teeth in the maxilla, mostly large and compactly one after another, the most posterior small and separated. All teeth wide, pointed, strongly flattened laterally, the medial and lateral side proportionally bulging and hardly distinguishable, sharp anterior and posterior margins with fine serrations. Developed with quite fine, SENKRECHTEN striations against the anterior edge and with weak transverse bulges. Larger maxillary teeth similar to *Carcharodon*, that is, not recurved, nearly bilaterally symmetrical, however with a convex edge. Wide anterior serrations, completely indistinct posteriorly. Teeth of the dentary bone of the anterior lower jaw likewise, however the anterior margin strongly arches against a point and the posterior margin is completely slightly concave.

Vertebrae: Short cervical vertebrae, decidedly opisthocoelous; centrum a little wider anteriorly than tall, laterally concave with ventral foramen in the middle with a pronounced median edge. Neural arch of the axis strong ascending posteriorly, spinous process almost just an edge on it. Anterior caudal vertebrae large, the centrum platycoelous, as wide as tall anteriorly, somewhat longer than tall; simply bulged ventrally. Foramen on the centrum as well as anterior to the lateral neural arch; the latter lead anteriorly in a deep notch under the base of the spinous process, also posteriorly at its notch. Cervical ribs completely flattened. Anterior chevron: shaft slightly curved, somewhat flat ventrally, haemal canal very tall, bridged over at the top by projecting edges at either side.

Hind limb: Ischial shaft more to the rear than underneath, with small obturator process, contact with the pubis very high. Pubic shaft not flat, curved somewhat sagittally, with very thin symphysis, gradually wider proximally and slightly curved laterally; underneath, an apparently small foot; without or only completely underneath with symphysis. Femur: Median part head bulged dorsally, greater trochanter sizable but not projecting up to the proximal end, with a lateral corner; fourth trochanter (= lesser) a short edge in the upper third of the shaft. Underneath anteriorly a narrow, deep medial furrow; medial from that a strong longitudinal edge; posteriorly both condyles parallel and projecting back almost to the same height, not wide medially, strongly convex posteriorly, a surface apparently towards the rear near the lateral side. Fibula: upper end rounded posteriorly, and medially strongly concave, a projecting anterior corner, medial part of the shaft mostly concave, distal end strongly widened; flat medially.

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Table Explanation.

All the illustrations except for Figures 1, 2, and 3 are drawn to 1/3 natural size and reduced to 1/6 natural size, in order to facilitate comparison with the illustrations of *Spinosaurus aegyptiacus* (STROMER, 1915).

Fig. 1: Isolated tooth, lateral view, natural size, anterior edge to the left. (The lower piece of the posterior margin has no connection with the larger piece of tooth.)
Fig. 2: Replacement tooth above, in the anterior left maxilla, medial view, natural size, anterior edge to the left.
Fig. 3: Replacement tooth above, in the anterior right maxilla, cross-section 1.3 cm below the apex, natural size, anterior edge to the left, lateral side at bottom.
Fig. 4: Braincase; a - right view, b - dorsal view, c - posterior view. The arrow points to the auditory meatus.
Fig. 5: Endocast; a - internal view, b - external view.
Fig. 6: Left maxilla; a - medial view, b - lateral view.
Fig. 7: Right nasal; a - dorsal and external view, b - ventral view.
Fig. 8: Axis in anterior view.
Fig. 9: Anterior cervical vertebra, left view.

Fig. 10: Anterior caudal vertebra; a - right view, b - anterior view.
Fig. 11: Anterior chevron; a - right view, b - anterior view, c - dorsal view, anterior edge is at the bottom.
Fig. 12: Left ischium in lateral view, anteroventral edge is at the bottom.
Fig. 13: Left pubis; a - lateral view, anterodorsal edge is at the left, arrow indicates location of the cross-section, b - dorsal view, c - midshaft cross-section, lateral edge at the top, anterior edge at the left.
Fig. 14: Left femur; a - anterior view, b - distal outline of the right femur, reversed to left, anterior side below, lateral side to the right.
Fig. 15: Left fibula; a - anterior and somewhat medial view, b - dorsal edge, medial edge underneath, anterior edge to the right, c - midshaft cross-section at the arrow, d - distal outline of mirror image, anterior edge below, lateral side to the right.