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1959-07-01
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NOTE ON A NEW SKELETON OF THRINAXODON LIORHINUS

By A. S. Brink

ABSTRACT

This is a short paper presenting two figures of a *Thrinaxodon liorhinus* skeleton, which is peculiarly curled as though the animal died under peaceful circumstances. An attempt is made to find an explanation for this peculiar attitude, but a more interesting aspect about the specimen is that it demonstrates the absence of any adverse influence which the overlapping processes of the ribs had on the general flexibility of the vertebral column.

In July 1956 Mr. J. W. Kitching visited Mr. Maurice Zunckel at his farm in the Bergville district, north-western Natal. Mr. Zunckel is a keen fossil hunter and has already recovered many good specimens over a wide area in northern Natal. These he has so far divided equally between the Bernard Price Institute, the Natal Museum (Pietermaritzburg) and the University of Natal (Durban). Mr. Zunckel had collected the specimen described here two months before Mr. Kitching arrived at his farm. He immediately donated it to Mr. Kitching, and both individuals set out for the locality where they recovered ten additional specimens.

The locality is in upper *Lystrosaurus*-zone beds exposed on the farm Newcastle (belonging to the Admiralty Estates of Bergville) in the Oliviershook mountain pass between Bergville in Natal and Harrismith in the Orange Free State. The present specimen is numbered 287 in the collection of the Bernard Price Institute. When disscovered, it was a complete round nodule, showing over the surface some small exposures of bone, enough to indicate that it contained a complete skeleton (of *Thrinaxodon liorhinus*). When cleaned, the specimen turned out to be rather complete and little distorted and to belong to *Thrinaxodon liorhinus,* but it is very intimately curled as though it died peacefully while asleep. It is this circumstance and the arrangement of the overlapping rib processes in this attitude that demand the figuring and description of this specimen.

I wish to extend my sincere thanks to Mr. Maurice Zunckel for this beautiful donation to the Bernard Price Institute and also for the numerous other specimens he has not only placed at our disposal, but also at the disposal of the other two institutions where they are safely housed and receive scientific attention. We are naturally also grateful to the Admiralty Estates for granting us permission to excavate fossils on their property.

Figures 5A and B were prepared as follows. Each view was drawn on a separate sheet of paper with the aid of a pantograph at twice natural size. Each was then retouched with more details obtained directly from the specimen and with the aid of proportional compasses. The two drawings were then attached back to back in as accurate an apposition as possible and the information contained in the one was traced through to the other, both ways. Once again each drawing was retouched to

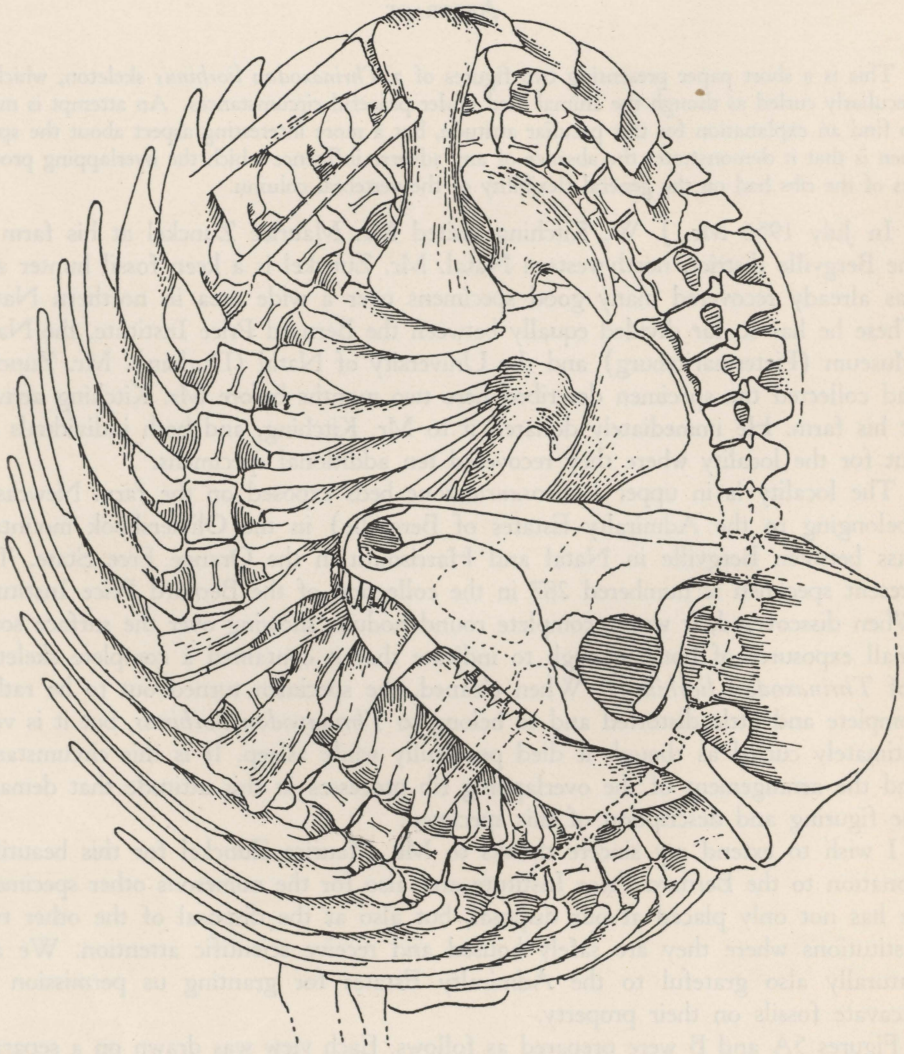


Fig. 5a—Ventral view of the skeleton of *Thrinaxodon liorhinus,* as preserved, natural size.

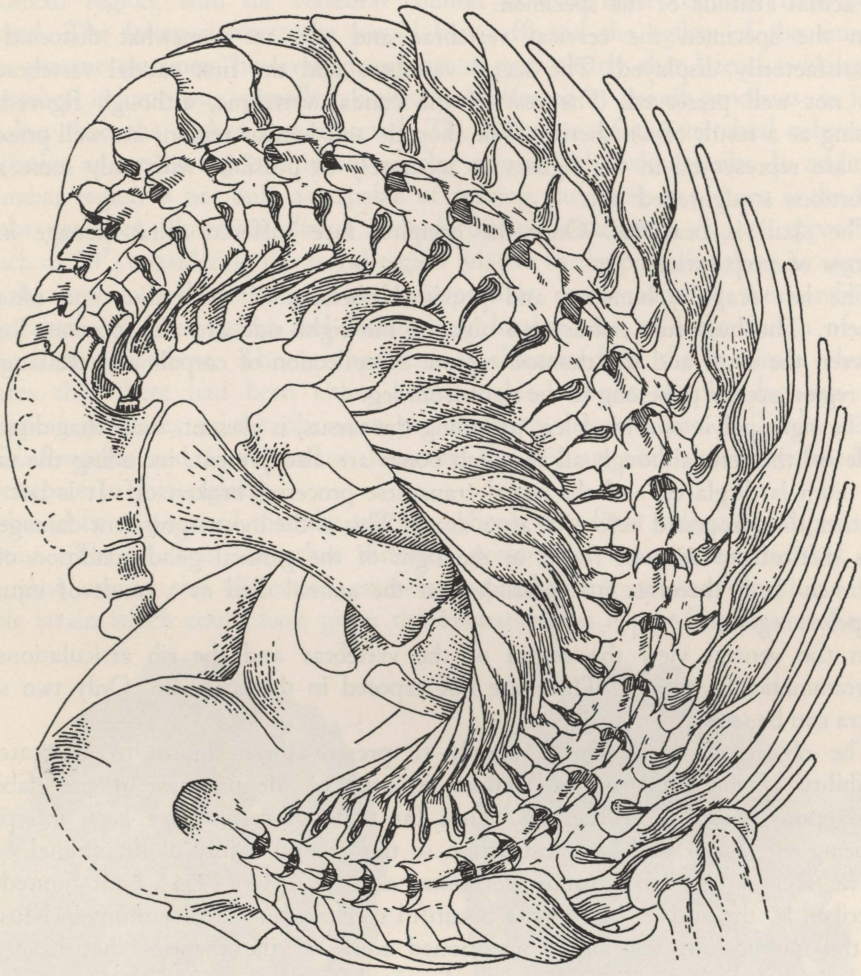


Fig. 5b—Dorsal view of the skeleton of *Thrinaxodon liorhinus,* as preserved, natural size.

average the traced information with the originally drawn details. Restorations were freely added in areas that are obscure on the specimen, based on information obtained from other specimens. The vertebral column and ribs are presented as being rather complete and well preserved in neat arrangement, which is not quite the case in the specimen. Some limb bones are left out as they obscure the structure and arrangement of the ribs. However, the figures still portray as accurately as possible the actual attitude of the specimen.

In the specimen the cervical vertebrae and ribs are somewhat distorted and unsatisfactorily displayed. The sacral vertebrae and the first caudal vertebrae are also not well preserved. The rest of the caudal vertebrae, although figured, are missing as a result of weathering. The thoracic and lumbar regions are well preserved and are represented in the figures as accurately as possible, with only some slight distortions straightened out.

The skull is beautiful. Only the occipital face suffered some damage in the process of preparation.

The left scapula, humerus and proximal portions of the radius and ulna are present. The humerus, radius and ulna of the right side are also present, located between the skull and the thoracic region. A collection of carpals and phalanges in this region appear to belong to the right front leg.

The right pelvis and hind leg, including the tarsus, is present, somewhat distorted, while on the left, although all the limb bones are also present, including the tarsus, the ilium is displaced and the sacral transverse processes broken off. It is not clear whether this happened before or after death. This is the most significant damage and it is difficult to account for it in the light of the general good condition of the specimen. It is therefore just possible that the animal died as a result of injury in the pelvic region.

In the ventral view the centra of the vertebrae and the rib articulations are diagrammatically figured. These are not exposed in the specimen. Only two sacral centra can be seen.

The object of this paper is merely to present these figures to illustrate the flexibility of the trunk in this animal, in spite of the presence of the elaborate overlapping processes of the ribs. Thus far these processes have been interpreted as being of greater or lesser obstruction to the general agility of the animal.

The skeleton of *Thrinaxodon liorhinus* has previously (1954) been figured and described by the author, based on a beautiful specimen in the Bloemfontein Museum. In this publication the author mentioned some of the theories that have been advanced on the function of these overlapping processes, e.g., protection, analogous to the Chelonian-like carapace, and strength, both from a strong musculature point of view and the support afforded against overdue flexion of the vertebral column. These functions had been evaluated mainly by Haughton in 1924. The author (1954) tentatively advanced a further theory, i.e., one which brings these processes into relationship with the function of breathing — the primary function of the ribs as such — and stated that it can be argued that they reflect the taking into commis-

sion of a diaphragm. This aspect is dealt with in more detail by the author in a subsequent publication (1956).

In these publications (1954 and 1956, as well as in another in 1955, dealing with the skeleton of *Diademodon*) the author expressed the opinion that lateral twisting of the body could not have been seriously obstructed by the overlapping processes, but rotation of a portion of the trunk, relative to another portion, especially across the lumbar region, with the vertebral column as axis, must certainly have been restricted. The latter circumstance would have affected the agility of the animal.

The present specimen, however, demonstrates very clearly that lateral twisting of the vertebral column was virtually completely unaffected by the rib processes; in fact, much less than the author had expected. The curvature of the vertebral column is as excessive as can be expected in any similar animal with ordinary ribs. In addition the lumbar region is not only as capable of curving, but more important is the fact that the specimen illustrates almost normal rotation within this region, apparently as much as 90°, considering the sacral region relative to the posterior thoracic region. This the author had considered to be impossible on account of the combined characteristics of overlapping and interlocking lumbar ribs, and the fusion of the ribs with the vertebrae. The arrangement as illustrated in the specimen clearly indicates that there had been either a reasonable amount of play between the overlapping processes or the ribs were not fused to the vertebrae in *Thrinaxodon* (in *Diademodon* and *Cynognathus,* however, the ribs are very definitely fused to the vertebrae in this region).

It should be emphasised that the specimen shows very little indication of pressure distortion. The skull is somewhat distorted posteriorly, but the direction of the strain that caused this distortion extends perpendicularly to the direction of a possible strain which could have given the lumbar region a post-fossilization distor-

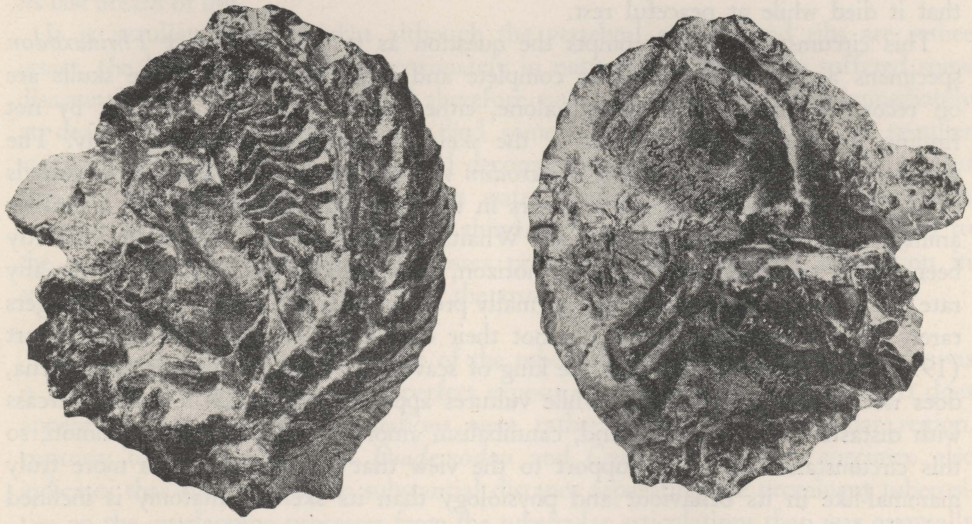


Fig. 6—Similar views as shown in Figure 5A and B, photographed, ½ natural size.

tion. But the ribs and dorsal processes of the vertebrae show no indication of pressure distortion, while such fracture distortion or dislocation as the pelvis had suffered cannot be brought into relationship with the rotation in the lumbar region if this is due to pressure. In the figures the ribs appear to be asymmetrical as though distortion had taken place, but this is due to the fact that they are projected on to a two-dimensional plane from their actual positions in the specimen where they are inclined at various angles.

The important function of the overlapping processes, as the author interprets it (1956), is to prevent a collapse of the trunk, or more particularly the thoracic region, subject to atmospheric pressure, if the intercostal muscles should fail to make their influence properly felt. This circumstance must be interpreted in the light of a diaphragm newly taken into commission, which has the effect of pulling the ribs of the two sides closer together. At this stage a proper co-operation between the diaphragm, which may have been more involuntary than in modern mammals, and the purely somatic intercostal muscles, had apparently not yet been established. Therefore, instead of an endeavour on the part of the intercostal muscles to hold the ribs in a stable position while the diaphragm contracted, the ribs developed these processes seeking support on the ribs behind. The present specimen now shows clearly that even though the animal died in this closely curled attitude, the trunk had not collapsed. This invariably happened in all the complete skeletons of other Karroo fossils which the author has investigated. The ribs are normally distorted, fractured or scattered; otherwise, when they are in good order, the trunk still illustrates a condition of collapse. In the present specimen the skeleton is not flattened into one general plane. The ribs actually outline the true shape of the trunk. The skull points in a direction approximately 45° downward from the plane in which the trunk is curled. On the whole the specimen creates the impression that it died while at peaceful rest.

This circumstance now prompts the question as to why it is that *Thrinaxodon* specimens are normally found as complete and intact skeletons. Where skulls are on record as having been found alone, either the collector was at fault by not finding the rest of the skeleton or the skeleton had been weathered away. The obvious reason for this is that *Thrinaxodon* was one of the few carnivorous animals of its time. *Scaloposaurus* which occurs in the same area and period was a smaller animal, while the larger carnivorous Whaitsiid *Moschorhinus,* which has recently been found to occur near the same horizon, was certainly not as plentiful. At any rate, carnivorous mammals do not normally prey on other carnivores. Even scavengers rarely devour carnivores, especially not their own kind. Hughes (1954) and Dart (1957) have observed that even the king of scavengers among mammals, the hyaena, does not devour its own kind, while vultures apparently approach a hyaena carcass with distaste. On the other hand, cannibalism among reptiles is rather common, so this circumstance may add support to the view that *Thrinaxodon* was more truly mammal-like in its behaviour and physiology than its skeletal anatomy is inclined to indicate.

It would appear, therefore, that *Thrinaxodon* was not normally preyed upon, and what is more, it normally died under circumstances where it immediately became embedded under suitable conditions for fossilization.

The environment at the time must have been fairly wet, with numerous marshes, judging from the apparent habits of the contemporary form *Lystrosaurus*. *Thrinaxodon,* therefore, evidently did not bog down in mud at drying oases as the case appears to have been in the later *Cynognathus*-zone period. It is more likely that at this time floods and drowning could account for the numerous intact and well-preserved skeletons of *Thrinaxodon*. However, the attitude of the present specimen certainly does not suggest that it died from asphyxiation at the mercy of a flood. Old age can hardly be taken into consideration in this animal which, on account of the absence of epiphyses on the long bones, is still a reptile where growth is not arrested; it shows no indication that it has reached an exceptional size. It is perhaps worth keeping in mind that it could have died at the mercy of an ailment (the damaged pelvis) or a parasite which did not make its adverse influence felt. Another explanation may be that this animal had a burrowing habit or occupied existing burrows and that it was caught by a flood in a confined recess. However, the specimen was discovered in perfectly stratified layers, as though it became embedded in the floor of a body of water, and it is unlikely that it would have made no endeavour to escape from its confined recess when water overcame it. It is, for example, peculiar that its head is still in position underneath the hind leg of the upward turned side in the attitude normally adopted by carnivorous and other mammals when sleeping in cold weather. Incidentally, this attitude is, to the best of the author's knowledge, never adopted by typical lizard-like reptiles. There remains the consideration that the animal died while hibernating or that it perished of cold. The only other explanation is that it adopted this attitude by accident at its last breath of life.

It is peculiar, however, that although the vertebral column and ribs are rather intact, the limb bones, while approximately in natural positions, have suffered some disarrangement. The animal could therefore not have been embedded immediately at death. It must, therefore, have died somewhere on dry land in this peculiar attitude, where it suffered some initial decomposition, and was subsequently washed into, or became covered by, stagnant water, while a tough, dried, mammal-like leathery skin kept it firmly intact. If this had been the case, support is added to the view that the overlapping processes present a very successful adaptation in stabilizing the shape and capacity of the trunk.

In the specimen the actual nature of the tubercular-transverse process articulations is not very clear as a result of imperfect exposure in the process of cleaning. It does appear as though these articulations were rather "loose" in the lumbar region, contrary to the condition in *Diademodon* and *Cynognathus*. This specimen also indicates that there is a more substantial distance separating the prominent tuberosities on the overlapping processes from the tubercular articulations than was originally

interpreted in the Bloemfontein specimen, as figured by the author in 1954. In figure 5b this distance appears to be greater on the convex left side than on the right. It appears that the tubercula should have been figured as having slipped more to the rear side of the transverse processes, thus reducing this distance to conform with the opposite side. Unfortunately the tuberosities on the overlapping processes lie so closely adjacent to the transverse processes of the vertebrae behind, that further development in an endeavour to ascertain the true relationship is rather difficult.

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