

A CARNIVOROUS DINOSAUR, *HALTICOSAURUS*, IN THE RHAETIAN OF AIREL (MANCHE).

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SUMMARY.

One tooth, thirty-five vertebrae, several bone fragments and coprolites were discovered in the blackish and sandy-clayey beds of the Airel quarry (southern border of the Carentan Basin). These reptilian remains are described and, after discussion and comparisons, attributed to the genus *Halticosaurus*, a carnivorous dinosaur from the Upper Triassic. The rarity of forms near this age brings out the interest of the study and the value of the locality.

Introduction.

The discovery of the fossiliferous Airel locality by C. PAREYN (fig. 1) led to attributing some detritic formations to the Upper Triassic, which until then had been considered as older (C. PAREYN and C. LARSONNEUR, 1960). Subsequently, the fauna and flora of this locality as well as the various facies of the region were described by one of us (C. LARSONNEUR, 1961 and 1963). More recently, some important specifications were brought by M. RIOULT (1964) on the Triassic-Liassic limit in Basse-Normandie. The Rhaetian was distinguished beneath the lower Hettangian by its continental formations and its flora and fauna, and the fossiliferous level of Airel must be attributed to this stage, whose facies extend those of the upper Keuper besides.

Figure 2 gives the section of the Airel quarry when it was still exploited. The fossils were recovered in the blackish, sandy-clayey beds that cover or prolong the sandy, sometimes plum-shaped limestone lenses. Mollusc shells form true marbles in places; numerous fragments of carbonized or calcified gymnosperms exist, and vertebrate remains were collected rather abundantly in 1959.

The remarkably conservative fishes were made the object of a detailed study (C. LARSONNEUR, 1964), which permitted specifying certain characters of the genus *Semionotus* and defining a new species *Semionotus normanniae*. The reptile remains were not yet determined, and it seemed possible to us to study them. Indeed, we arrived at some interesting results which we make known here.

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Description of the elements.

The material examined includes: one tooth, 35 vertebrae, 7 fragments of vertebral processes, and 2 portions of pelvic bone. All the elements were recovered in the eastern sector of the quarry, at the same level, and they belong undoubtedly to a single animal whose carcass had floated into an estuarine zone.

Tooth.

We collected a small 2 cm tooth, slightly recurved and of flattened form (fig. 3). The edges are trenchant and serrated. Viewed under the loupe, the serrations are of the type ornamenting the teeth of carnivorous dinosaurs, so that this trenchant tooth “at the same time is a knife, sabre and saw” according to BUCKLAND’s remark.

This tooth differs from those of prosauropods such as *Plateosaurus* (= *Thecodontosaurus*), whereas it must be attributed to a theropod. Its shape evokes those of the teeth of Keuper carnosaur, such as *Teratosaurus* and related forms (*Palaeosaurus*, *Pachysaurus*), or better those from the Rhaetian designated under the varied names of *Zanclodon*, *Avalonia*, and *Picrodon*, and which it is necessary to group within the genus *Gresslyosaurus* (SEELEY, 1898; NEWTON, 1899). But our tooth also corresponds well to those of *Halticosaurus*, a coelurosaur from the Upper Triassic (HUENE, 1934).

We cannot choose between these alternatives with a single tooth. But there are vertebrae that orient us toward *Halticosaurus*.

Cervical vertebrae.

We have seven more or less complete cervical vertebrae, remarkable for their elongation. V¹ and V², the most characteristic, are two joined vertebrae belonging to the anterior part of the neck (Pl. I, fig. 1 and 2). At first they are striking by their elongation and the narrowness of the median part of the centrum. The zygapophyses are very long and project anteriorly. V¹ must be considered as one of the very first cervicals.

Here are some measurements in mm:

	length	height	disc diameter	
			anterior	posterior
V ¹	70	37	25	
V ²	85	25		30

V³ and V⁴ are the same size as V² and show the same characters, although one has only two joined halves. They seem to follow immediately the two preceding vertebrae. V⁵ is the posterior half of another cervical. V⁶ and V⁷ are two joined, very incomplete half-vertebrae. They also show the double character of these cervicals: great elongation and notable narrowness of the vertebral centrum.

Such elongation of the neck of the animal, revealed by these vertebrae, is not so frequent in dinosaurs. It does not exist to the same degree in the Keuper (*Teratosaurus*, *Palaeosaurus*) or Rhaetian (*Gresslyosaurus*) carnosaur, as far as is known. In contrast, this character corresponds to the coelurosaurs, supple and gracile animals with elongate and very mobile necks. Indeed, we do not know of complete skeletons other than those of *Compsognathus* and *Halticosaurus* (HUENE, 1934) from the Keuper and Rhaetian.

The vertebrae from the Airel quarry that we have come to examine are very similar to the cervicals of *Halticosaurus*. It is known that the American Triassic coelurosaur *Coelophys* also has a very long neck.

Dorsal vertebrae.

The dorsal vertebrae found at Airel are three in number. They are easily referred to a theropod dinosaur. They greatly resemble the dorsal vertebrae of *Gresslyosaurus*; however, they are a little less massive and resemble still more those of *Halticosaurus* (Pl. I, fig. 3 and 4).

Note the following characters: flat anterior disc; slightly concave posterior disc, larger than the anterior; well-marked carina on the keel, whose posterior part is extended down. The prezygapophyses are wide and flat; the postzygapophyses are short and very squared. The start of the ribs is preserved on V8; two rib fragments were found stuck on V⁹.

V⁸ can be attributed to an anterior dorsal.

A groove is observed on the keel of V⁹ and V¹⁰ instead of a carina, and the posteroventral elongation is much more accentuated.

Here are the measurements in mm:

	length	disc diameters	
		anterior	posterior
V ⁸	70	47 x 52	55 x 55
V ⁹	71	52 x 59	47 x 58

Sacral vertebrae.

The sacral vertebrae, not fused together, seem to number five. They are characterized by their very ventrally excavated shape. The flat and proportionally very wide vertebral discs form solid articular surfaces.

V¹¹, V¹², and V¹³ on the one hand, and V¹⁴ and V¹⁵ on the other, are joined in the same block; but V¹³ and V¹⁵ preserve only their anterior halves.

The sacral vertebrae seem to pass progressively to the first caudal vertebrae: it is possible that V¹⁴ and V¹⁵ should already be counted among the anterior caudals. V¹¹ has a length of 77 mm; V¹² measures 75 mm long.

These diverse characters are found on the sacral vertebrae and first caudals of the skeleton of *Halticosaurus*.

A wide, short rib, accidentally stuck against ischial fragment no. 37, seems to belong to the sacral region.

Caudal vertebrae.

The twenty caudal vertebrae of the Airel animal are very narrow and tend to be greatly elongated. They show all the characters of the caudal vertebrae of coelurosaurs and deviate from those of carnosaurus.

The middle caudals, from V¹⁶ to V¹⁸, are still relatively massive (Pl. II, fig. 1).

The posterior caudals, from V¹⁹ to V³⁵, diminish in size progressively but slowly, which indicates a very long tail. They are thinned and become rather strongly amphicoelous. From V²³ to V³⁵ their length passes from 77 mm to 70 mm. Figures 2 to

9 of plate II show sufficiently the shape of the better preserved ones and give an idea of these vertebrae, which armed a very long tail.

We also note seven isolated fragments of small caudal vertebral processes among the bones recovered from Airel.

Pelvic bone.

We have two portions of bone from the pelvis of the Airel reptile, but they are very incomplete.

We can only think that one (no. 36) might be a proximal portion of pubis, and the other (no. 37) a proximal portion of right ischium. Indeed, on this latter the excavation corresponding to the articulation with the head of the femur is seen.

Comparisons and discussion.

First of all, the several reptile bones found in the Airel quarry could have appeared too fragmentary to form the object of a specific study.

However, there were two favorable factors. The first came from the fact that no part was duplicated, and the second that all the bones were found in the same bed and in the same sector of the quarry. It could be deduced with semi-certainty that they formed a single animal. So the 45 bony pieces acquired a real interest.

On the other hand, the Rhaetian age of the locality oriented and limited the researches at the time, because the dinosaurs at the end of the Triassic are not very numerous in Europe, and all the remains known had been minutely described.

Having rapidly acquired the conviction that the Airel bones belonged to the same individual and to a dinosaurian reptile, we initially thought of comparing them to those of Triassic prosauropods. But the teeth and also the vertebrae are different. It is certain that the Airel reptile is not a prosauropod.

We must then turn to the theropods. There is a certain resemblance between the Airel tooth and those of *Teratosaurus*, or those found formerly in the Rhaetian of England (NEWTON, 1899; SANFORD, 1894; SEELEY, 1895) and the Hettangian of Lorraine (TERQUEM, 1885). In the same way, the dorsal vertebrae are rather close to those of *Gresslyosaurus*.

However, it greatly resembles the coelurosaurs. Those from the Triassic are rather poorly known, except by chance a complete skeleton of *Halticosaurus* (HUENE, 1934; LANG and HUENE, 1952). This large animal, 5.50 m long, had a skull bearing cutting and serrated teeth, nine very elongated cervical vertebrae, unfused sacral vertebrae, and a very long tail. We consider the attribution of the Airel reptile to the genus *Halticosaurus* as very probable. Figure 4 shows the form of the skeleton of this animal.

Continuing the comparisons, we note that *Procompsognathus* from the Keuper of Wurtemberg is a somewhat comparable coelurosaur, but much smaller: only one meter long. Regarding *Saltopus* from the Triassic of Scotland, it measures only sixty centimeters.

In contrast, a good-sized coelurosaur is known in the Upper Triassic of America, named *Coelophysis* (COLBERT, 1947). This carnivorous animal bore serrated teeth; it

had a long neck and tail, a slender and narrow pelvis; it measured from 2 to 3 m. The skeleton from the Triassic of Connecticut named *Podokesaurus* is considered by COLBERT (1964) to be a small *Coelophys* (one meter long). However, the bones studied here do not seem to be referable to the American genus *Coelophys*.

Finally, at Airel we are in the presence of a large coelurosaurian carnivore, very similar if not identical to *Halticosaurus* from Germany. This comes from the upper Keuper: it was found 14 m below the Rhaetian. This stratigraphic position is very close to that of the Airel beds considered as Rhaetian.

We also note that three coprolites containing fish teeth and scales were found in the same fossiliferous beds of Airel. As we do not know any other carnivore in the locality, it can be supposed that these remains belonged to *Halticosaurus*, more especially as certain anatomical characters, such as the very mobile and elongate neck and the relatively reduced teeth, agree well with a carnivorous regime based on fishes.

To finish, we can evoke the recent discoveries at Veillon in the Vendée, where a rich and varied Rhaetian reptilian fauna was revealed only by footprints (BESSONAT, LAPPARENT, MONTENAT and TERN, 1965; LAPPARENT, MONTENANT and DESPARMENT, 1966). The petrographic facies of Airel are in places so similar to those of Veillon that samples from these two localities cannot be distinguished. However, great footprints named *Grallator maximus* are found in abundance at Veillon (fig. 5), which could well be due to the passage of herds of *Halticosaurus*, whose foot with three very long digits corresponds to this type of prints.

Thus, the footprints left by *Halticosaurus* in the search for prey along the edges of a beach in Vendée, and the fossil bones of a carcass of *Halticosaurus* floated in an estuarine zone in Normandy, have been discovered in France nearly at the same time. The age of these fossils can be evaluated as some 180 million years ago, approaching the boundary of Triassic and Liassic times.

BIBLIOGRAPHY.

See original text.

FIGURE CAPTIONS

FIG. 1. — Map of the situation of the Airel locality in Basse-Normandie.

FIG. 2. — Schematic section of the Airel quarry.

1. *Sharp red clay*, becoming slightly sandy in the western sector of the quarry.
2. *Whitish clay*.
3. *Calcareous-sandy* or *plum-shaped lenses* and *blackish sandy clays* with oblique stratification; this is the fossiliferous level.
4. *Gray clay*, slightly sandy.
5. *Orange clay*, sometimes red or white, becoming more and more sandy toward the summit.
6. *Quaternary terrace* with pebbles, gravels, sands, and clays.

FIG. 3. — a. Tooth of *Halticosaurus* sp. (x 1/4). b. Detail of a (x 32).

FIG. 4. — Reconstruction of *Halticosaurus* according to HUENE; length of the animal: 5.50 m.

PLATE I.

Halticosaurus sp. Airel (Manche).

FIG. 1. — Cervical vertebrae V^1 and V^2 , left side (x 1/2).

FIG. 2. — Cervical vertebrae V^1 and V^2 , right side (x 1/2).

FIG. 3. — Dorsal vertebrae V^8 and V^{10} (x 1/2).

PLATE II.

Halticosaurus sp. Airel (Manche).

FIG. 1. — Middle caudal vertebrae V^{17} (x 1/2).

FIG. 2 to 9. — Posterior caudal vertebrae V^{21} , V^{22} , V^{23} , V^{26} , V^{28} , V^{32} , V^{33} , and V^{35} (x 1/2).