NOTE ON SEVERAL NEW REPTILE FOOTPRINTS
observed in the Middle Triassic of the Antully Plateau (Saône-et-Loire, France)

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Summary: Paleozoological interpretation of new trackways attributed on the one hand to paleopods and bipedal coelurosaurs between 1.40 and 3 m long, and on the other to quadrupedal pseudosuchians whose size could have been between 2.80 and 4.60 m.

Introduction.

In 1970, following the discovery of very fossiliferous ichnological beds in the Triassic arkose quarries of Saint-Sernin-du-Bois, I reconstructed a first reptile trace assemblage, which was the object of study at the time (G. GAND, 1971). Faced with this encouraging result, the systematic exploitation of the locality was then undertaken and permitted reconstructing 6 others to add to the first. It is the second part of this first assemblage that is the object of this note today.

More than 600 counter-prints were counted there, all attributed to already known ichnological species, and in addition to the trackways of the first assemblage that continue on the second, the addition of this slab allows observing others that are specifically the object of a succinct paleozoological interpretation in the following lines.

Unfortunately, it remains that many among them are not readable, and this is particularly the case for those of *Rotodactylus lucasi*. As has already been discussed elsewhere (G. GAND, 1977) regarding other ichnological beds, this is due on the one hand to the rapid variation of the hydric quality of the soil, and on the other to the great density of the animal, to which must be added the capricious mode of locomotion of the authors of these *Rotodactylus* traces: animals that were obviously very agile and able to become facultatively bipedal in the manner of several recent lizards.

In addition to the footprints, this second part also shows several good counter-prints of tails. But curiously no autopod can be unquestionably allotted to them (1). The very sinuous, bilaterally symmetrical tail already indexed in 1971 could nevertheless be due to a lepidosaurian. Indeed, this lizard-shaped animal left several *Rhynchosauroides*

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* Original citation: Gand, G. 1979. Note sur quelques nouvelles pistes de reptiles observées dans le Trias moyen du Plateau d'Antully (Saône-et-Loire – France). *Bulletin trimestriel de la Société d'Histoire naturelle et de Amis du Muséum d'Autun* 92:7-20. Translated by Matthew Carrano, Department of Anatomical Sciences, Stony Brook University, August 2002.

(1) However, the discontinuous tail on the assemblage is referred to the author of the *Rotodactylus lucasi* traces.

traces parallel to this trace. Regarding the new, slightly curvilinear tail that is duplicated (2) on one part of its length, a stride of *Brachychirotherium* seems to be referred to it.

PALEOZOOLOGICAL STUDY OF THE TRACKWAYS.

A. – METHOD USED.

In order to avoid repetitions, the reader will wish to refer to the original work of G. DEMATHIEU (1970), and concerning the dinosauroid trackways more specifically, that of G. DEMATHIEU and G. GAND (1972), where the methods used for the approximate determination of the dimensions of the animals who left their trackways are detailed.

B. – RESULTS.

1) *DINOSAUROID TRACKWAYS.*

a) Trackways of* Coelurosaurichnus perriauxi DEMATHIEU and GAND 1972, *attributed to paleopod saurischians.

To the two trackways D and E already known, five others must be added: X, Y1, Y2, Y3, and O, of which one very long trackway, O, which includes no fewer than 9 prints, is very interesting when the conditions of the locality are known.

For this trackway, as for the others besides, initially it is easy to appreciate the sometimes significant morphological variability of the autopodia, however left by the same animal. The relatively large number of footprints then makes it possible to measure the variability of certain characters with some security (3), and in this regard it appears clear, notably for trackway O where n = 9, that if the length of the traces varies little (K% = 8.10 %), in contrast it is not so for the angular variation separating the outer digits. The large value of the coefficient of variability (K% = 38.61%) consequently must lead to greater prudence when using this character in specific determinations. (Within trackway O, this angle varies from 20° to 47°.)

Regarding the measurements of the new trackways, one can see in consulting Table 1 that they are close to trackways D and E, which of course supposes animals of comparable size. Reasoning here in the same manner as in a preceding study (DEMATHIEU and GAND, 1972), the average dimension of the stride of each trackway thus permits encircling it, in terms of approximating the length of these bipedal reptiles. The smallest—those of track O—could reach around 2 m, those of trackways X, Y2, and Y3 are close to 2.50 m, and the largest must be the reptile of trackway Y1 at around 3 m long.

The foot angles include between 161° and 176°, moreover indicating animals with very straight hind limbs but with rather a heavy step, if one refers to the negative value of foot angle with the axis.

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[2] Such a doubling is explained very well by the changing of the orientation of the end of the tail, which became oblique relative to the direction of motion.

[3] In this short note, I present only a summary statistical study. However, I have calculated the statistical parameters for each of the characters, which will be published later in a synthetic framework. Concerning simply the dinosauroid tracks M and O, in addition to the great value of the coefficient of variability of the angle t, I also remark on the IV/II ratio due to the great variation in the length of the digit II trace. During locomotion, support thus seems to be especially carried out on digits III and IV.

b) Trackways of* Anchisauripus bibractensis DEMATHIEU 1967*, attributed to coelurosaur saurischians; trackways A, B, and M.

On the first part of the assemblage, trackway M was only known by a single print. It is continued on the second part, with the ensemble totaling 10 prints.

As for trackway O, if the autopod length varies little (K% = 5.06%), it is entirely different for the angle t that measures the variation of digits II and IV, because its coefficient of variability reaches 31.65% here. The angle varies between 12° and 32° with an average of 23°.

The dimensions of the other trackways A and B having already been discussed, I will not return to them here.

The mean stride value of 763 mm permits proposing an approximate length of around 2 m for its author, a bipedal reptile whose size was thus slightly greater than those of reptiles A and B, respectively 1.40 and 1.85 m long.

2) *TRACKWAYS OF* SPHINGOPUS *ATTRIBUTED TO THEROPODS.*

a) Trackways of* Sphingopus ferox DEMATHIEU 1966*.

Trackway H is also continued on this second part. The new measurements hardly modify the results already acquired, so that I can renew my interpretation of 1971. Thus it appears that *Sphingopus ferox* was undoubtedly a much more bipedal than quadrupedal animal, because the manus trace is only left about once for every four times. The size of this animal was between 2.50 and 3 m, making it an already very frightening beast.

Concerning the author of trackway Z, like its size, its silhouette must have been very comparable to those of the preceding reptiles, because the trackway measurements are very close to those of track H.

b) Trackway G of* Sphingopus *sp.

In truth, this is a curious trackway because its different characters vary greatly. The mean stride value leads to imagining a slightly larger animal than the preceding ones, close to 3 m long, and in the present case entirely bipedal.

3) *TRACKWAYS OF* BRACHYCHIROTHERIUM PACHYDACTYLUM DEMATHIEU and GAND 1973, *ATTRIBUTED TO PSEUDOSUCHIANS.*

They are rather numerous on this second part of assemblage BF2 because 8 of them could be measured. All denote quadrupedal animals with very straight limbs, with the foot angle averaging 158°, not being equal on the 8 (4).

If this angle varies little (K% = 3.46 %), it is not at all the same for the position of the manus relative to the pes, because the coefficient of variability calculated along the pes-manus pair is 28.74% with $n \geq 9$.

Then I ask myself what the reason is for such variability, and I researched whether there is any relation between the form of the animal and the position of the manus. Taking only the tracks left by animals of comparable size, then one realizes it is nothing, because the coefficient of correlation r calculated from the foot angle and the length of the pes-manus pair is 0.166.

Therefore the position of the manus is random during locomotion, which is well understood besides since it is known that the center of gravity of these animals was rather

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[4] The standard deviation is 5.46; the standard error of the mean = 1.930.

near the acetabulum, situated between one-quarter and one-third of the glenoid-acetabular length. Such a position equally explains well the occasional bipedalism of these heavy reptiles, which trackway W clearly shows, being reduced only to pes traces.

Having already interpreted 4 *Brachychirotherium* trackways with some details in a preceding study (G. GAND 1975), I content myself to give here only the results relative to the size of each animal.

P: 3.38 to 3.62 m – Q: 3.37 to 3.63 m – R: 4.30 to 4.61 m – S: 3.00 to 3.21 m – T: 2.80 to 3.07 m – U: 3.89 to 4.17 m – W: 2.88 m – I2: 4.06 to 4.26 m.

Although approximate, these dimensions show that the animals were of different ages. They also underline the important of biomass.

Conclusions.

For reasons linked to the exploitation of the fossil locality, it was not possible for me to study this second part of assemblage BF2 with the first. The ichnological interest of this new document nevertheless encouraged me to study the ensemble, and at the end of this short note which takes account of that of 1971, assemblage BF2 will have delivered ultimately a great number of reptile traces, some attributable to lepidosaurians (*Rhynchosauroides* traces) or theropods (*Anchisauripus*, *Coelurosaurichnus*, and *Sphingopus* traces), and others to pseudosuchians (*Brachychirotherium* and *Rotodactylus* traces).

For their dimensions (5), the number of the tracks, of which 21 could be measured, the density and variety of the prints, this assemblage BF2 constitutes a very interesting document, and in certain regards a reference document for the study of the regional ichnofauna of the Middle Triassic.

Torcy: August 1979.

[5] Once gathered, the 2 parts will add up to a large slab 5.68 m long and 3.86 m wide. The assembly will be made in total or in part at the Autun Natural History Museum, where this material is now already preserved. In this connection, it is particularly agreeable to me to thank **Mr. G. Pacaud**, conservator of the museum, for the efficacious and precise help which he accorded me on many occasions.

CHARACTERS	n	AVERAGE	STANDARD DEVIATION	K%	STANDARD ERROR OF THE MEAN
L or III	8	54.75	2.77	5.06	0.979
II	7	26	2.56	9.85	0.967
IV	5	41.40	4.02	9.73	1.797
t	6	23	7.27	31.65	2.969
III/IV	4	1.280	0.141	11.05	0.070
III/II	5	2.116	0.241	11.38	0.107
IV/II	5	1.651	0.352	21.33	0.157

Table 2. – Elementary parameters of the frequency distributions of the pedal character measurements from trackway M of ***Anchisauripus bibractensis***.
(III/IV represents the ratio of the lengths of digits II and IV, etc…).

CHARACTERS	n	AVERAGE	STANDARD DEVIATION	K%	STANDARD ERROR OF THE MEAN
L or III	9	70.44	5.70	8.10	1.90
II	6		6.475	16.89	2.64
IV	8		4.351	8.65	1.53
t	6	32.50	12.54	38.61	5.12
III/IV	7	1.391	0.133	9.60	0.050
III/II	5	1.864	0.10	5.76	0.04
IV/II	5	1.353	0.250	18.55	0.11

Table 3. – Elementary parameters of the frequency distributions of the pedal character measurements from trackway O of ***Coelurosaurichnus perriauxi***.

FIGURE CAPTIONS

Plate 2. – **The different types of traces:**
A: pes of ***Sphingopus ferox***
B: pes of ***Coelurosaurichnus perriauxi***
C: pes-manus pair of ***Rotodactylus lucasi***
D: pes-manus pair of ***Brachychirotherium pachydactylum***
E: pes of ***Anchisauripus bibractensis***
F: pedes of ***Rhynchosauroides***.

Plate 3. – Trackways O, X, Y1, Y2, and Y3 of ***Coelurosaurichnus perriauxi***
Trackways M and B of ***Anchisauripus bibractensis***
Trackways H, G, and Z of ***Sphingopus ferox***.

Plate 4. – Trackways of ***Brachychirotherium pachydactylum***.

Plate 5. – Stereoscopic view of the southern part of the assemblage (cf. the scheme of the situation, pl. 1).

Plate 6. – Stereoscopic view of the southwest part of the assemblage. Observe trackways P, U, H, G, and M (cf. the scheme of the situation).

Plate 7. – Evocation of Triassic life in the St.-Sernin-du-Bois region.
(Reconstruction realized with data from assemblage BF2.)
– In the foreground, agile ***Rotodactylus*** are confronted by two carnivores, a ***Coelurosaurichnus*** with a rather heavy step and a more rapid ***Anchisauripus***.
– In the background, a redoubtable ***Sphingopus ferox*** follows two herbivores, ***Brachychirotherium***.