FOSSIL VERTEBRATE TRACKS NEAR MURRAYSBURG, CAPE PROVINCE

by

C. S. MacRae

Geological Survey of South Africa, Private Bag X112, Pretoria 0001

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ABSTRACT

The presence of a palaeosurface with a set of relatively large concave epirelief tracks that extend for some 60 m is documented and described. The trackmaker is believed to be a member of the genus *Aulacephalodon* Seeley 1898 or *Rhachiocephalus* Seeley 1898 and to have walked across a submerged silty surface on a floodplain. A mud veneer deposited under relatively low energy conditions soon after the tracks were made, and the thermal alteration of the sediment by nearby diabase intrusives, contributed to the preservation of this set of fossil tracks

INTRODUCTION

A set of fossil vertebrate concave epirelief tracks in sediments of the Beaufort Group was discovered by the author and his wife on the farm van Tonders Kraal, Murraysburg District, Cape Province, South Africa, and this report is the first documentation of this ichnofossil. Palaeoichnology – the study of fossil traces of the activity of formerly living organisms (fossil biogenic structures) – affords some insight into physical and biological environs that existed during the formation of the fossil. The present fossil is composed of two separate but spatially closely associated trackways produced by the causal organisms' having walked in the same direction. It extends over a total distance of some 60 m. Despite the diverse Beaufort Group fauna, there are relatively few records of fossil trackways (see Seeley, 1904; Watson, 1960; Stear, 1978; Smith, 1980; Fountain, 1985; and de Beer, 1987).

LOCALITY

The fossil occurs to the east and west of the river ford approximately 1,5 km east of the van Tonders Kraal homestead on the farm track leading to the Nelspoort/ Murraysburg secondary road (fig. 1). The palaeosurface forms a slightly raised portion of the river bed which is not under water during normal river flow conditions.

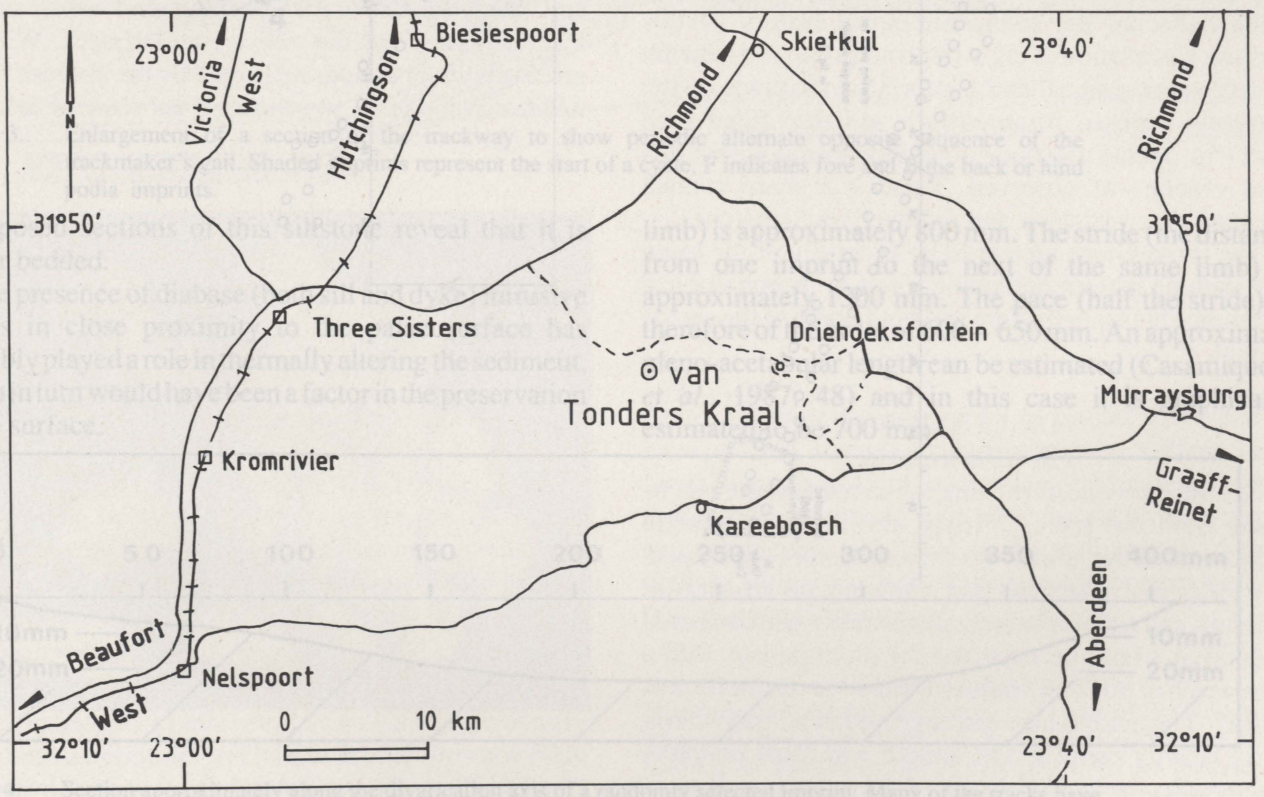

Figure 1. Locality map of the vertebrate tracks on the farm van Tonders Kraal near Murraysburg, Cape Province.

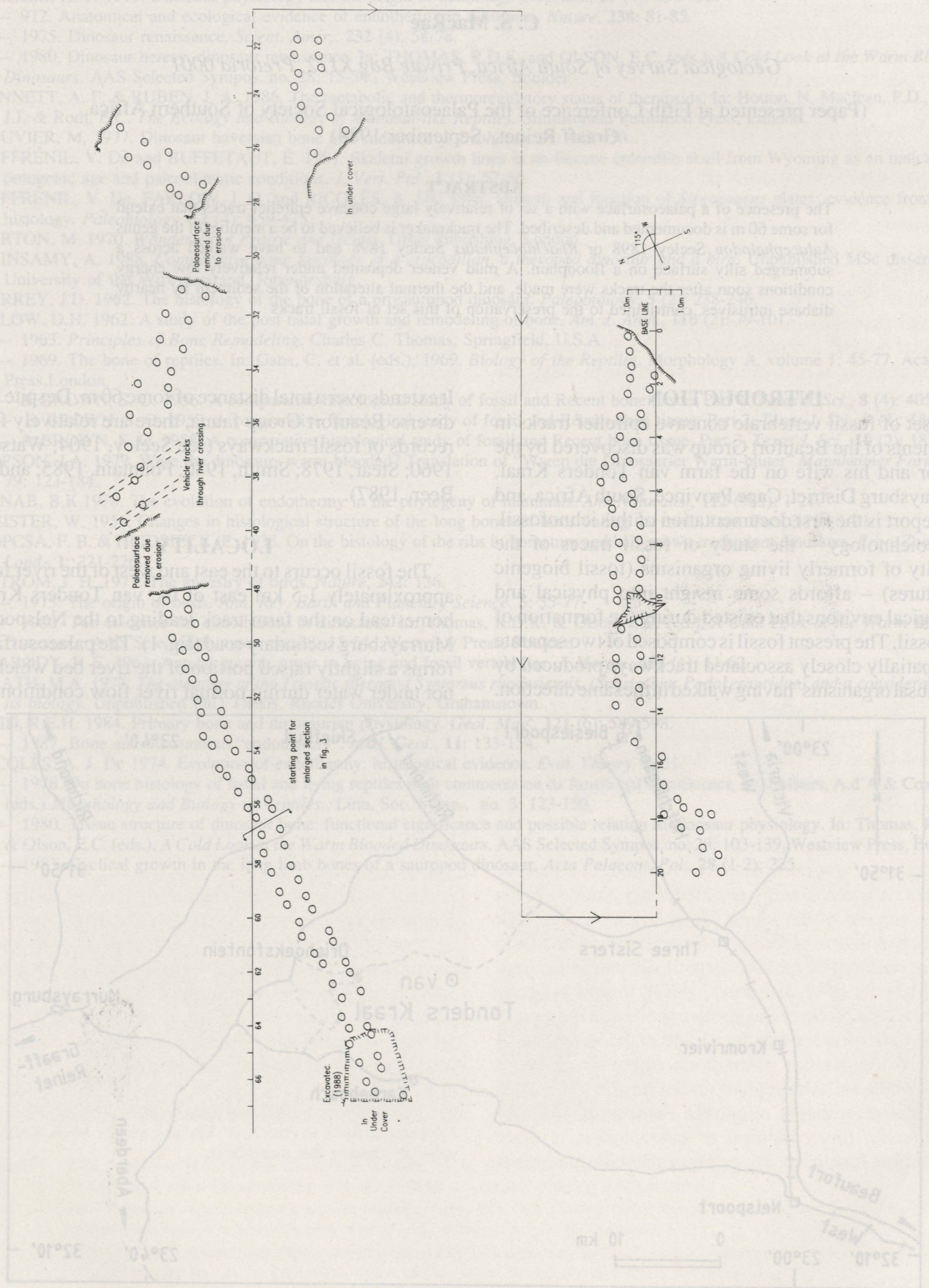

Figure 2. Detailed map of the tracks on the palaeosurface. Baseline distances in meters.

GEOLOGICAL SETTING

The ichnofossil is imprinted in a green/gray coloured fine grained siltstone of the Karoo Sequence, Beaufort Group, Adelaide Subgroup, Teekloof Formation. Preliminary biostratigraphic results (Keyser, pers. comm.) indicate that this siltstone occurs within the *Aulacephalodon-Cistecephalus* Assemblage Zone of Keyser and Smith (1979). In places there are poorly developed straight crested symmetrical ripples, whose crests have an axial trend of approximately 024 degrees. The exact morphology of the ripples is indistinct, either because they were initially poorly developed or possibly as a result of exposure to some minor secondary reworking. The data are neither sufficient nor suitable to determine a current direction.

DESCRIPTION OF THE TRACKS

Description of the Trackway

Two trackways are evident (fig.2). They are of similar dimensions and might have been produced by the same animal or by two specimens of the same species. The tracks indicate that the causal organism was a quadruped. The sequence of the imprints indicates that the animal had a primitive alternate pace with support on the diagonal limbs changing periodically (fig. 3). The approximate inside width between the left and right foot tracks is 500 mm. The external trackway width is about 1050 mm. The pace width (measured at right angles to the midline and from centre of an imprint to the centre of the imprint produced by the corresponding but opposite

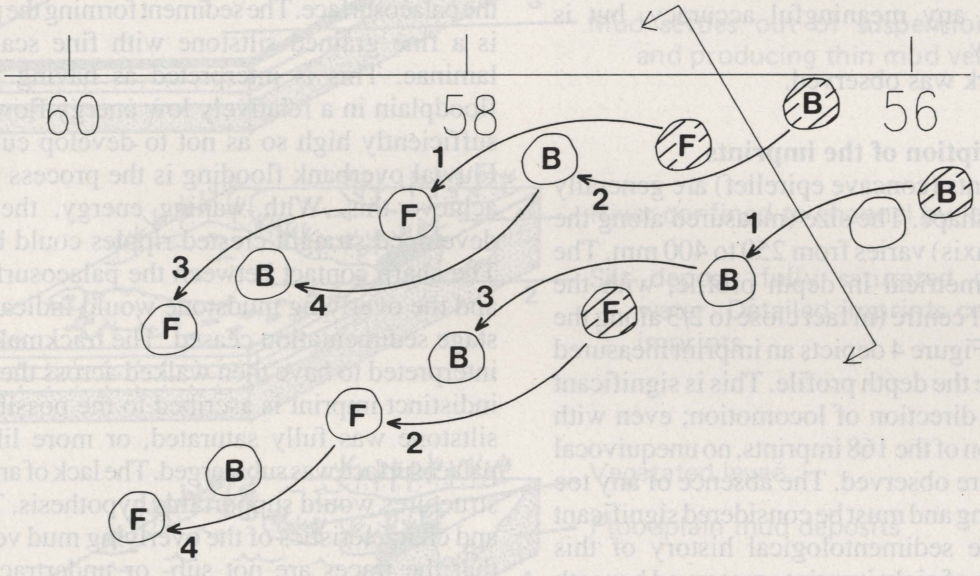

Figure 3. Enlargement of a section of the trackway to show periodic alternate opposite sequence of the trackmaker's gait. Shaded imprints represent the start of a cycle, F indicates fore and B the back or hind podia imprints.

Exposed sections of this siltstone reveal that it is planar bedded.

The presence of diabase (both sill and dyke) intrusive bodies in close proximity to the palaeosurface has probably played a role in thermally altering the sediment, which in turn would have been a factor in the preservation of the surface.

limb) is approximately 800 mm. The stride (the distance from one imprint to the next of the same limb) is approximately 1300 mm. The pace (half the stride) is therefore of the order of 600 – 650 mm. An approximate gleno-acetabular length can be estimated (Casamiquela *et al.*, 1987: 48) and in this case it is graphically estimated to be 700 mm.

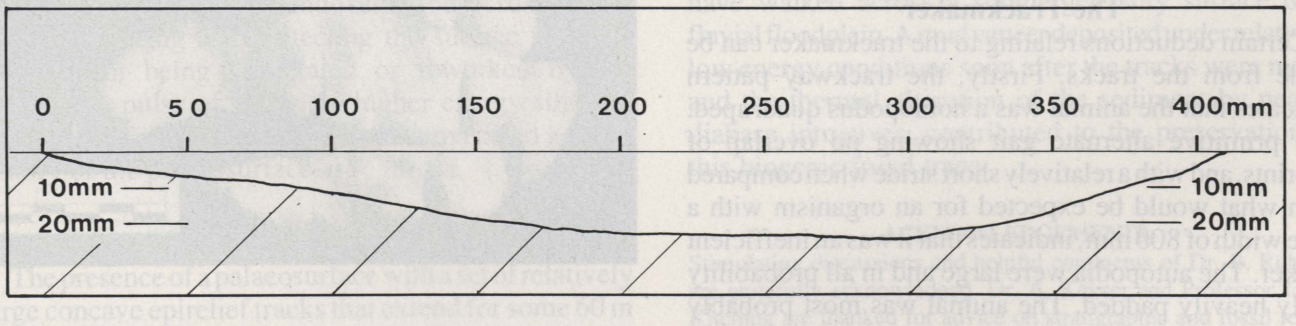

Figure 4. Section approximately along the divarication axis of a randomly selected imprint. Many of the tracks have this characteristic profile.

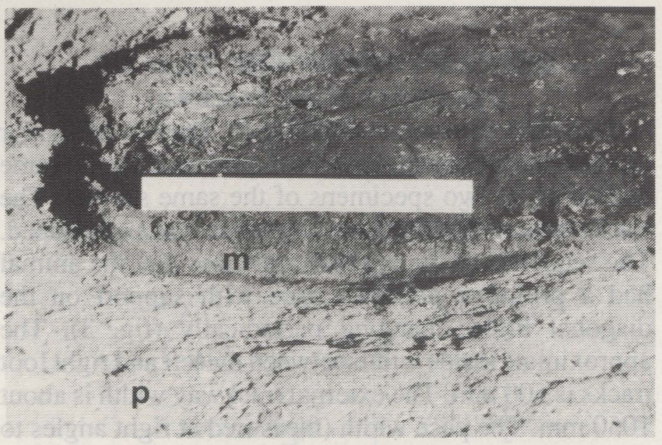

Figure 5. Photograph of the excavated surface showing an imprint on the siltstone palaeosurface (p) and the mud (m) infilling.

The divarication angle in the present tracks is difficult to determine with any meaningful accuracy, but is generally fairly low.

No tail drag mark was observed.

Description of the imprints

Individual imprints (concave epirelief) are generally circular to oval in shape. The size (measured along the divarication angle axis) varies from 250 to 400 mm. The imprints are asymmetrical in depth profile, with the deepest part well off centre (in fact close to 2/3 along the divarication axis). Figure 4 depicts an imprint measured in detail to illustrate the depth profile. This is significant in determining the direction of locomotion; even with detailed examination of the 168 imprints, no unequivocal toe impressions were observed. The absence of any toe imprints is interesting and must be considered significant when deducing the sedimentological history of this surface. Excavation of eight imprints preserved beneath rock cover revealed that the imprints were made on the presently exposed palaeosurface and then filled with mud (fig. 5). No evidence of an impression within this mud veneer was observed. There is a sharp contact between this mudstone and the overlying siltstone.

The impressions appear to be generally of the same size with no pattern indicating a size or morphological difference between the fore and hind podia of the causal animal.

DISCUSSION

The Trackmaker

Certain deductions relating to the trackmaker can be made from the tracks. Firstly, the trackway pattern indicates that the animal was a homopodus quadruped. The primitive alternate gait showing no overlap of imprints, and with a relatively short stride when compared with what would be expected for an organism with a pace width of 800 mm, indicates that it was an inefficient walker. The autopodia were large and in all probability fairly heavily padded. The animal was most probably plantigrade, the lack of distinct digit or toe impressions being due to the particular suite of physical conditions present in the sediment at the time the tracks were made. The size of the trackway, coupled with the indirect biostratigraphic evidence that the palaeosurface occurs within the *Aulacephalodon-Cistecephalus* Assemblage Zone, indicates that the trackmaker was probably a member of the genus *Aulacephalodon* Seeley 1898 or *Rhachiocephalus* Seeley 1898. Figure 6 illustrates the skeletal remains of an *Aulacephalodon* foot and it affords some idea of the morphology of the autopodium that is believed to have made the tracks. Skeletal remains of members of both these genera have short tails (Kitching, pers. comm.). This would be consistent with the absence of tail drag marks.

The Sedimentary Environment

Sedimentary structures are disappointingly rare on the palaeosurface. The sediment forming the palaeosurface is a fine grained siltstone with fine scale horizontal laminae. This is interpreted as having formed on a floodplain in a relatively low energy flow regime, but sufficiently high so as not to develop current ripples. Fluvial overbank flooding is the process postulated to achieve this. With waning energy, the few poorly developed straight crested ripples could have formed. The sharp contact between the palaeosurface siltstone and the overlying mudstone would indicate that at this stage sedimentation ceased. The trackmaker(s) is (are) interpreted to have then walked across the surface. The indistinct imprint is ascribed to the possibility that the siltstone was fully saturated, or more likely that the palaeosurface was submerged. The lack of any desiccation structures would support this hypothesis. The presence and characteristics of the overlying mud veneer suggest that the traces are not sub- or undertraces. Within a relatively short period, supported by the absence of any additional biogenic structures, a subsequent influx of

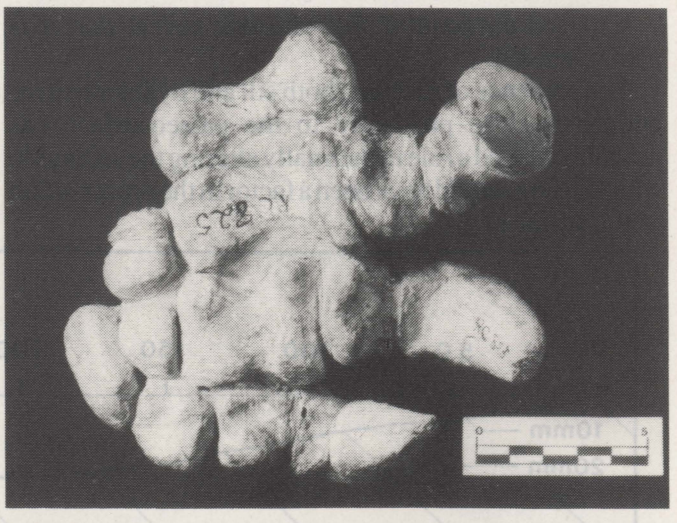

Figure 6. Skeletal remains of an *Aulacephalodon* foot. Specimen from the Rubidge Collection, Wellwood.

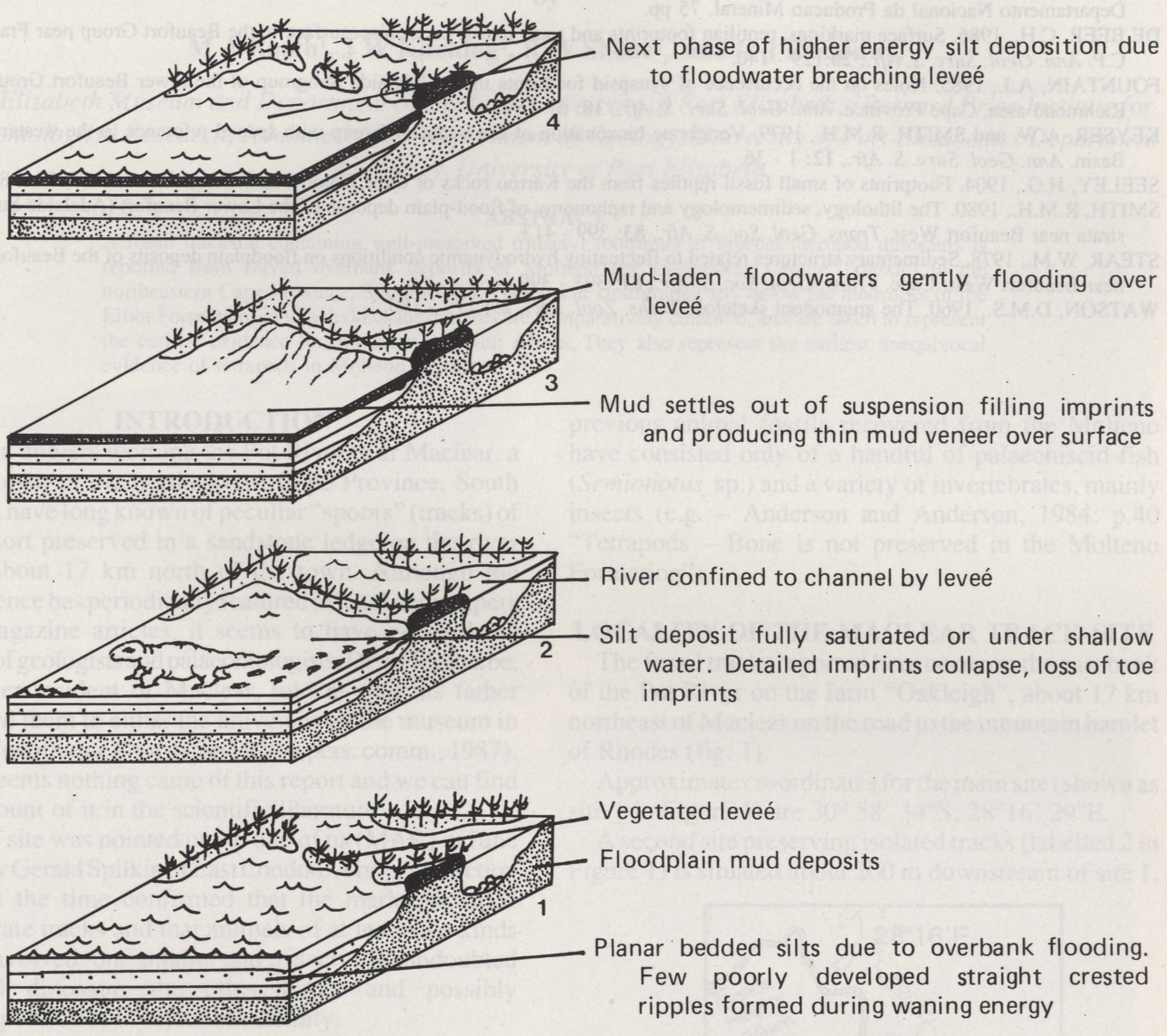

Figure 7. Summary of the envisaged genetic history of the palaeosurface.

mud-laden overbank floodwater took place under relatively low energy conditions. The mud settled out of suspension, thereby covering and protecting the surface with the tracks from being obliterated or reworked by the subsequent pulse of relatively higher energy siltstone deposition. Figure 7 summarizes the envisaged genetic history of the palaeosurface.

CONCLUSION

The presence of a palaeosurface with a set of relatively large concave epirelief tracks that extend for some 60 m has been documented and described. The trackmaker is believed to be a member of the genus *Aulacephalodon* Seeley 1898 or *Rhachiocephalus* Seeley 1898 and to have walked across a submerged silty surface on a fluvial floodplain. A mud veneer deposited under relatively low energy conditions soon after the tracks were made, and the thermal alteration of the sediment by nearby diabase intrusives, contributed to the preservation of this biogenic fossil trace

ACKNOWLEDGEMENTS

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