Acknowledgments

I thank John Reed and Peter Klevberg for helpful suggestions on this manuscript.

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Dinosaur footprints, fish traces and the Flood

John Woodmorappe

Vertebrate footprints can be found throughout much of the upper two-thirds of the standard Phanerozoic geologic column. Some of these footprints occur at stratigraphic horizons that are, according to orthodox uniformitarian geology, tens to hundreds of millions of years *older* than the supposed first appearance of the animal that made them.[1] However, the occurrence of footprints is, at times, needlessly supposed to be a hindrance to our understanding of the Flood origins of most Phanerozoic sedimentary strata. Actually, small changes in floodwater levels would have easily allowed the temporarily surviving animals to make numerous footprints, and to do so repeatedly at successive local horizons within sediment. However, it is astonishing to realize that certain fish can make traces that resemble dinosaur footprints. This admits the possibility that many 'vertebrate track' surfaces in the fossil record do not require *any* subaerial exposure of sedimentary surfaces during the Flood.

Vertebrate footprints and the Flood

The Noachian Deluge is commonly misconceived, tacitly if not openly, by anti-creationists and neo-Cuvierists[2] alike, as a one-time rise of water over the continents. This misunderstanding prompts the fallacious argument that vertebrate footprints in the Phanerozoic are incompatible with the global Flood origins for the contained sediment. In actuality, owing to such factors as tectonic upheavals of the land and ocean surfaces, the floodwater must have flowed and ebbed many times, on a scale ranging from local to subcontinental, before finally submerging all land areas globally for a certain period of time. Consequently, the land animals were not drowned as a result of single movement of floodwater, but were killed in a more attritional manner. Meanwhile, many temporary survivors were able to walk on the recently emerged surfaces, which consisted of unlithified sediment deposited by earlier pulses of flowing floodwater. Oard[3] demonstrated the feasibility of the genesis of the extensive early-Flood dinosaur footprints over much of the western United States.

We must remember that the very high width/depth ratio of floodwater allows a very small change in topography to expose significant strips of land that can henceforth be walked on by any land vertebrates still surviving. For instance, assuming a flood that is 1 km deep, a mere 1° change in slope, sustained over a lateral distance of 100 km, translates into a 43 km wide swath of exposed land.[4] In those locations where the Flood-land boundary is oscillating but relatively stable for at least a few days, numerous horizons of vertebrate footprints could have been locally generated.[5] Even if large animals were carried away by the floodwaters, many of them would have still survived such an episode, and been once again able to make footprints in sediment, provided that the water re-deposited them on a land surface within a few hours of their initial flotation. This follows from the fact that large animals are known to be able to swim distances of at least a few kilometres[6] and for durations of at least several hours.[7] Finally, it would only require a small number of vertebrates to survive temporarily to be able to make an astonishing number of footprints in a short period of time. For instance, one horse can produce 10,000 footprints in only one day.[8]

An alternate cause for 'dinosaur' footprints

Up to now, the factual identity of vertebrate tracks has been accepted as a given. Recently however, Martinell *et al.*[9] advanced the provocative thesis that a series of traces found in

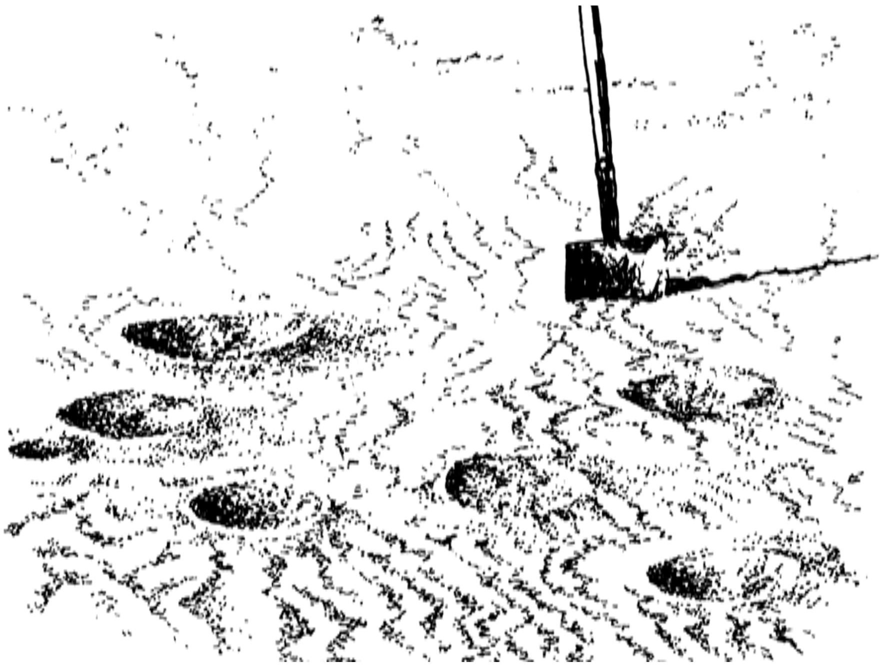

Figure 1. A sketch from Photo B, Figure 10 of Martinell.[15] *The depressions are not dinosaur footprints but stingray pits, and they occur on a tidal flat in Estero Moruo, western Mexico.*

the Upper Cretaceous of northeastern Spain, and long accepted, as a matter of course, as dinosaur tracks, are actually traces caused by ray (elasmobranch) fish. Certain stingray pits encountered on the tidal flats of western Mexico inspired this revolutionary notion. The Mexican surface markings have an uncanny resemblance to dinosaur traces,[10] with some of them even occurring in a pattern that resembles the strides of walking vertebrates (Figure 1 & 2).

A close examination reveals that the 'dinosaur trackways' in northeast Spain lack certain details typical of other accepted dinosaur tracks. Yet it is not as easy to distinguish genuine dinosaur footprints from ray traces as one would intuitively suppose.[11] For instance, the presence of imprints of digits and other anatomical details would clinch any dinosaur-track interpretation, but it is acknowledged that weathering often removes such details from dinosaur tracks. How important weathering was at any given site is itself a matter of interpretation. Soft-sediment deformation under a trace would point to a heavy dinosaur stepping on the surface, yet it is acknowledged that the absence of internal lamination in the sediment would hide this feature, once again making interpretations of trace origin ambiguous.

The report suggests that, whereas genuine dinosaur footprints have flat bottoms, stingray pits have concave interiors. However, Martinell *et al.* do not present any measurements of trace-contours in order to verify the universality of this observation, much less that it is necessarily applicable to *every* type of pit-making fish. Finally, unlike dinosaur tracks, stingray pits supposedly never overlap each other. However, it seems unwise to make such a generalization based on only *one* observation of undoubted fish-made pits.

Detailed stride patterns would certainly indicate the locomotory movement of dinosaurs, but a certain degree of linearity in the deployment of traces may be fortuitous (not to mention potentially exaggerated by the imagination of the observer). Moreover, when traces are abundant and overlapping it is often difficult to recognize clear trackway patterns. Finally, it can be added that a statistical program could objectively distinguish overlapping strides from the less-collinear stingray traces.[12] However, many outcrops show only a few traces at a given locality, making it all the more difficult to make firm generalizations about stride patterns.

Much more study is obviously warranted before we have solid criteria for distinguishing genuine dinosaur trackways from traces formed by fish. Furthermore, Martinell *et al.*'s surprising discovery has obvious implications beyond the questioning of dinosaur trackways. A thorough study should be undertaken of all marine creatures and their abilities to generate apparent land-vertebrate tracks. As for the fossil record, *all* vertebrate tracks, which up to now have been accepted as such without question, should be re-examined for their actual origins, and even classified according to the relative certainty of their identity as incontrovertible vertebrate tracks. Flood models should be adjusted accordingly.

Conclusion

Regardless of their exact origins, footprints have never posed a difficulty for the global Flood, and have never presented themselves as a legitimate excuse for neo-Cuvierist compromises. Moreover, with the discovery that many 'dinosaur footprints' may actually be surface traces caused by fish, a Flood-centered explanation for many of the 'vertebrate tracks' encountered in the Phanerozoic record is made even easier. Obviously, fish can generate such traces at virtually any stage of the Flood, obviating in such cases the need for exposed land surfaces and the temporary survival of land vertebrates.

There is also a lesson here for the field geologist. Ovate depressions found in bedding planes should no longer automatically be assumed to be vertebrate tracks. Instead, those traces whose layout and/or morphology cannot certainly be attributed to walking vertebrates should be recognized as being of ambiguous origin. Currently, Walker's model[13] of the Flood utilizes footprints to help

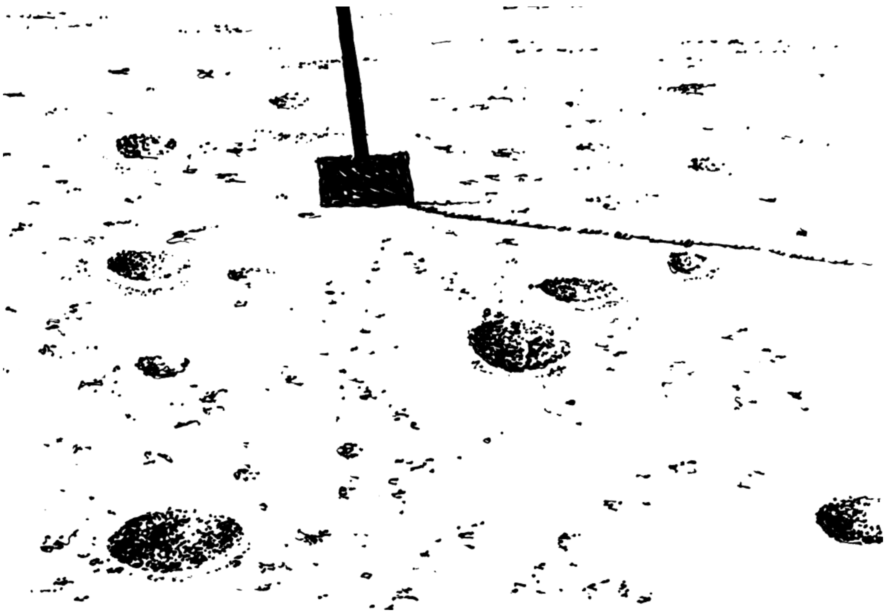

Figure 2. A sketch from Photo A, Figure 10 of Martinell.[15] *Once again the depressions are not dinosaur footprints but stingray pits.*

distinguish Inundatory-stage rocks from Recessive-stage rocks. This is based on the supposition that vertebrate footprint-makers were alive towards the earlier stages of the Flood, but not the latter, and is definitely valid in the case of genuine dinosaur footprints. After all, we now realize that, contrary to earlier suppositions, dinosaurs were not semi-aquatic, and therefore could not possibly have survived the Flood outside the Ark.[14] Fish, of course, are completely adapted to prolonged life in water. So, in contrast to indisputable dinosaur tracks, traces which are attributable to fish markings, or those which are ambiguous in origin, could have occurred anytime during the Flood. Clearly, these should not be used to help decipher the Flood stage to which their host rocks belong.

References

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2. Neo-Cuvierists are those who, while professing creationism and a belief in the global extent of the Flood, are quick to discount a Flood origin for sedimentary rocks whenever there is an apparent evidence for long periods of time. As a result, the Flood is relegated to a progressively smaller geologic influence in their thinking, as was the case with the ideas of Baron Cuvier, their namesake. Most if not all neo-Cuvierists falsely consider vertebrate footprints as indisputable evidence for non-Flood origins of the rock. Consequently, according to their mistaken thinking, the upper two-thirds of the Phanerozoic sedimentary column cannot be of Flood origin.
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5. Woodmorappe, J., Some additional comments on 'Concerning Several Matters', *CRSQ* **23**(2):81, 1986. Each time part of the local area is submerged, the dinosaurs or other vertebrates flee to the adjacent areas not then covered by water. A cyclic retreat of the floodwater enables them to return (and make footprints upon), the newly exposed sediment. The total number of footprint horizons generated is directly proportional to the number of times that this cycle repeats itself locally. Only when the Flood encroachment is geographically complete, and persistent, are all the dinosaurs and other vertebrates drowned, and the footprint-making process stopped.
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7. Schoener, A. and Schoener, R.W., Experiments on dispersal: short term floatation of insular anoles, with a review of similar abilities in other terrestrial animals, *Oecologia* **63**: 290–292, 1984. Elephants, rabbits, and pigs have been known to be buoyed for distances ranging from 50 to 150 km. Animals the size of skunks, woodchucks, and didelphid marsupials, can swim for a few hours up to tens of hours. Of course, during the Flood, many animals could have survived longer by attaching themselves to floating objects.
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12. A statistical evaluation of the data could, for instance, be based on the fact that footprint length tends to correlate with stride length, at least on a log-log scale (See Fig. 7 of Farlow *et al.,* Theropod Locomotion, *American Zoologist* **40**:653, 2000). The footprint-to-stride ratios of extant large birds tend to overlap those attributed to bipedal ornithischian and theropod dinosaurs. However, the scatter in the data is large. A specific footprint length is usually associated with a range of stride lengths that span half an order of magnitude (i. e. a factor of three between the smallest stride length and the largest). Moreover, before this information could be used as a paleontological tool, it would be necessary to systematically compare the length-spacing ratios of various fish traces with the footprint-to-stride ratios of undoubted vertebrate footprints in order to ascertain the degree of discriminatory power of the two sets of ratios. Using such ratios to distinguish vertebrate traces from fish traces would work only if the ratios of the two sets of data turn out to be substantially different, and with only a small overlap.
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