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# TRACKWAYS IN THE STORMBERG

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Vertebrate trackways in the lower groups of the Karoo Supergroup are mainly pre-Beaufort fish trails, although some tetrapod trackways are known (Griffiths, 1963, p. 292; plate I; specimens in the South African Museum). Recently fish trails have been discovered in the Beaufort, for instance at Kilburn and Wagondrift, but the Beaufort, despite its rich amphibian, reptilian and synapsid fauna, is remarkable for the paucity of its vertebrate trackways. Of the Stormberg (of Lesotho) it was early noted "Fossils are comparatively rare, but reptile tracks are fairly abundant" (Dornan, 1905, p. 405).

In 1966 Mr. Ken Tinley discovered footprints in the Clarence formation (Cave Sandstone) of Giants Castle, and further study in the area with him revealed some ten different types of vertebrate trackways. These were reported at the 64th Congress of the South African Association for the Advancement of Science in Stellenbosch in 1966. Photographs were sent to Rev. Dr. Paul Ellenberger at Quthing, Lesotho, and formed the basis of new taxa incorporated in a report at the 2nd Gondwana Symposium in Cape Town in 1970, viz. *Dinapentadiscus vandijki, D. lentus, Molapopentapodiscus (Dipodiscus) supersaltator,* and *Vandijkopentapus giantcastlensis* (Ellenberger, 1970, p. 350; p. 354; pl. XI, figs. 114, 115, 118 and 119).

These Stormberg trackways occur in the basal zone of the Clarence formation in deposits overlying channel sediments which mark the transition between the Elliot and Clarence formations (Red Beds and Cave Sandstone). The trackway-bearing sediments show the characteristics of a playa lake. Subaerial exposure is indicated by mudcracks, and the action of thin films of water by rünzel marks. Lake margins are indicated by etch-marks and drainage rills. Trackways occur in both emergent and subaqueous deposits. The deposits consist largely of graded beds apparently produced by sheet flow, and sole-marks are in evidence: flutes, tool-marks and prods. Some footprints are associated with such sole-marks (fig. 1). In addition to footprints there are what appear to be snail trails *(Scolicia)*, and (fig. 5) small sinusoid trails. As may be expected in ephemeral lakes, invertebrate tracks are rather uncommon, and indeed the preservation of the graded bed laminations is here attributed to periodic drying up that inhibited any development of a burrowing invertebrate fauna (cf. Blatt, Middleton and Murray, 1972, on carbonate rocks).

There are three factors which probably aided preservation of the footprints and also increased the probability of finding them in these sedimentary rocks in contrast to those of the Beaufort: because of the difference in grain size between the coarser sediments at the bottom of the bed and the finer sediments at the top of the preceding bed, bedding planes develop readily and expose footprints on the top of the bed during subsequent weathering; the sheet flow may destroy footprints by scouring, but may preserve them by infilling with a material differing from the substrate on which they were made; less bioturbation in playa deposits results in better preservation of bedding planes. It is also likely that the shallow margins of playa lakes would have attracted animals in an arid environment. Beukes (1970, p. 327) concluded that playa lake deposits occur in the upper Cave Sandstone — his Zone III.

Owing to variability in substrate consistency the footprints vary considerably in depth and some of the larger prints are sometimes relatively shallow, having been made on a firmer substrate. Quadrupedal and bipedal walking (figs. 1 and 2) and bipedal hopping (figs. 3–5) sequences are in evidence. In all these modes of locomotion there are instances where the impressions were transmitted to a deeper layer, as well as being preserved on the surface on which the footprints were made. The lower impressions may, in fact, be clearer than the actual footprints, since wind may wrinkle the footprinted surface, producing rünzel marks, and sole marks of the succeeding graded bed may also affect the prints.

In some of the prints of *Molapopentapodiscus supersaltator* Ellenberger the lower impressions are particularly clear and there are sufficient of them for analysis (figs. 3 and 4). Comparison of the actual prints with the lower impressions reveals an interesting feature, overlooked for some time because of rünzel marks on the footprinted surface. The lower impressions surprise with their clarity when it is borne in mind that the animal was a bipedal hopper, and the impressions represent the effects of both landing and take-off. The footprinted surface shows what appear to be quite deep skid marks behind each print, but these are not represented in the lower impressions; this supports the conclusion that they are skid marks made at a low angle, and not evidence of a "heel"-print projecting behind each footprint.

Besides the prints represented in the sequences in figs. 1–5, a few isolated prints are sufficiently clear to warrant illustration. Two of these are shown in figs. 6 and 7.

The environmental setting of footprints at Kamberg, at the same stratigraphical level and 20 km east of Giants Castle, has not yet been studied, and the trackway occurrences in Lesotho and the Orange Free State also require further study in this connection.

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Figure 1. Ceiling of an overhang showing natural casts of prints of walking dinosaurs (at least two types) and sole marks produced by sheet flow in a direction left to right or right to left. (Scale = 1 $cm^2$)

Figure 2. Slab showing natural casts of prints of a walking dinosaur of a larger species than those in Figure 1. (Scale = 1 $cm^2$)


Figure 3. Upper surface of a slab reassembled from scree fragments, showing the prints of the hopper *Molapopentapodiscus (Dipodiscus) supersaltator* Ellenberger. The photograph was taken with the light to the right and the relief will become unambiguous if the page is turned so as to have the right-hand margin uppermost. Compare Figure 4. (Scale = 1 cm²).

Figure 4. Lower surface of the same slab as in Figure 3, photographed with the light on the left. The natural casts of the prints show less ambiguity in relief than the prints in Figure 3. Note that the one footprint of the middle pair is absent as it lies beyond the right-hand margin of the slab. Note the desiccation cracks (Scale = 1 cm²)


Figure 5. Upper surface of a slab reassembled from scree fragments, showing prints of *M. supersaltator* (A, top left, facing down to the left, and middle right, facing upwards) and of another hopper with three strongly curved toes directed forwards and one toe directed to the side and somewhat backwards. (B, right footprint at bottom right and middle top, with other prints superimposed on the left footprints, at the bottom left it being another right footprint which is superimposed and another left footprint is visible top right). Note also the sinuous trail (C) across the middle of the figure, and the desiccation cracks (D). (Scale = 1 $cm^2$)

Figure 6. Footprint on a fragment detached from the overhang of which Figure 1 illustrates a part. (Scale = 1 $cm^2$)

Figure 7. Footprint on a slab reassembled from scree fragments. Less deep prints of this type are represented in fair numbers. (Scale = 1 $cm^2$) There is a similarity to the much smaller *Prototrisauropodiscus minimus* Ellenberger, from Falatsa in Lesotho (op. cit. plate VIII, fig. 13, on p. 366).