A RESTUDY OF SOME FOSSIL FOOTPRINTS FROM THE PERMIAN OF MANSFIELD (NOTTS.)

by

William Antony S. Sarjeant

Summary

A series of footprints from Mansfield, originally collected by James Shipman and described by Hickling (1906), is re-examined. It is shown to be the holotype material for the trace-fossil species Chelichnus hicklingi Nopcsa, 1923, for which an emended diagnosis is proposed. The interpretation of the footprints is discussed.

Introduction

Fossil footprints of different types of animals (invertebrate and vertebrate) occur throughout the geological column, from the Cambrian onwards. They are preserved where a sediment surface has been soft enough to retain an impression, yet coherent enough to remain undisturbed by deposition and compaction of overlying sediments. The footprint itself forms a cast, into which the overlying sediment enters to form a mould; footprints therefore survive as fossils either as concave impressions in a bedding plane, or as convexities on the lower surface of the overlying beds.

Very rarely, prints may be linked to the actual remains of an animal, proving beyond doubt what creature formed them. Thus for example, the museum of the Solenhofer Aktien-Verein (Solnhofen, Bavaria) contains a slab of Jurassic lithographic stone showing a trackway of tiny prints leading to the fossil remains of a king-crab (Limulus s.l.). The tracks in this instance were undoubtedly those of the king-crab.

Much more often, however, footprints are found in isolation and shells or skeletons are found in isolation; the association of one with another is a matter of deduction only. In the Mesozoic, large, three-toed footprints are found, with the prints of the toes almost parallel. The prints are of the hind foot, no prints of the fore-foot being found: this, then, was a biped. The depth and size of the tracks, and the length of the stride, show that the animal was very large. We can be certain that such tracks were made by members of a group of large, heavy, carniverous dinosaurs, the Carnosaurs. We cannot, however, confidently state which species of Carnosaur made the footprints, partly because the soft parts (not preserved) contributed to the form of the imprint, partly because the footprints of closely related species may well have been indistinguishable.

Palaeontologists have therefore found it necessary to erect a framework for the independent naming of footprints (together with other traces of the life processes of organisms, such as tubes, burrows and worm-casts). Such trace-fossils are classed into what are termed "ichnogenera" and "ichnospecies"; the footprints mentioned above are, for example, placed in the ichnogenus Eubrontes E. Hitchcock. This naming procedure facilitates description and discussion; description is done on morphological grounds, without implication of any relationship .

The Mansfield footprints

In October, 1897, Mr. Francis Holmes of Leicester discovered a series of footprints in a quarry at Mansfield. The footprints were located on a bedding-plane surface in Permian sandstones; they formed two double rows, approximately parallel, crossing the slab very nearly from east to west. The longer series could be traced for nearly 7 feet; the shorter, by its side and about a yard away, could only be followed satisfactorily for about 2 feet.

Mr. Holmes communicated his discovery to the Nottingham geologist, James Shipman, who examined them on October 21st, 1897 and took immediate action for their preservation. Nearly the whole of the longer series was extracted in a slab; and the prints from the right side of the shorter series were also preserved. (The overlying slab, with the natural casts, had already been removed for commercial purposes before the footprints were noticed.) Shipman's intention to describe the footprints was never carried out, as a result of his premature death in 1901. Instead, the study of the footprints was taken up by George Hickling, who published a full and thorough description of them in 1906. *

Hickling concluded that the tracks were of two animals of the same type, walking side by side; one slightly larger than the other, as indicated by the stride. They were plantigrade, the weight being taken on the palm; the hind-feet were larger than the fore-feet, and each had five digits, the first of which was reduced and the fifth set slightly apart. He considered the feet to be webbed and possibly clawed. The stride was short and he considered,from the irregular spacing of the prints, that the gait was clumsy and awkward. His paper is illustrated with a (very reduced) photograph of the large slab and with photographs of plaster casts made from both sets of tracks. The large slab he notes as being lodged in the Free Public Museum, University College, Nottingham; the smaller section as in the Manchester Museum, Owens College, Manchester.

Hickling's conclusions on nomenclature were highly tentative, he notes what he considers a "striking resemblance" to tracks from the Upper Permian of Thuringia (Pabst, 1897), as Ichnium acrodactylum; and to unnamed tracks described by Huxley (1877) from the Elgin Sandstones of Scotland and by Varty Smith (1884) from the Permian of Penrith. Later, in a review of British Permian footprints (1909), Hickling expressed his disapprobation of the allocation of biological names to footprints; he gave sketch figures of the Mansfield prints, designating them as "Chelichnoid forms, Cl.7". They constitute the earliest recorded footprints from the Permian of the English Midlands.

In 1923, Baron Franz Nopsca referred briefly to Hickling's footprints; decided they merited distinction at specific level; and accordingly proposed the name Chelichnus hicklingi (p.130); he gave no further description or figure. Hickling's 1909 drawings were used as illustration of C. hicklingi by Kuhn (1958, pl. 5, figs. 30-1).

In 1959, Hermann Schmidt, dealing with footprints from the Cornberger Sandstein (Permian)

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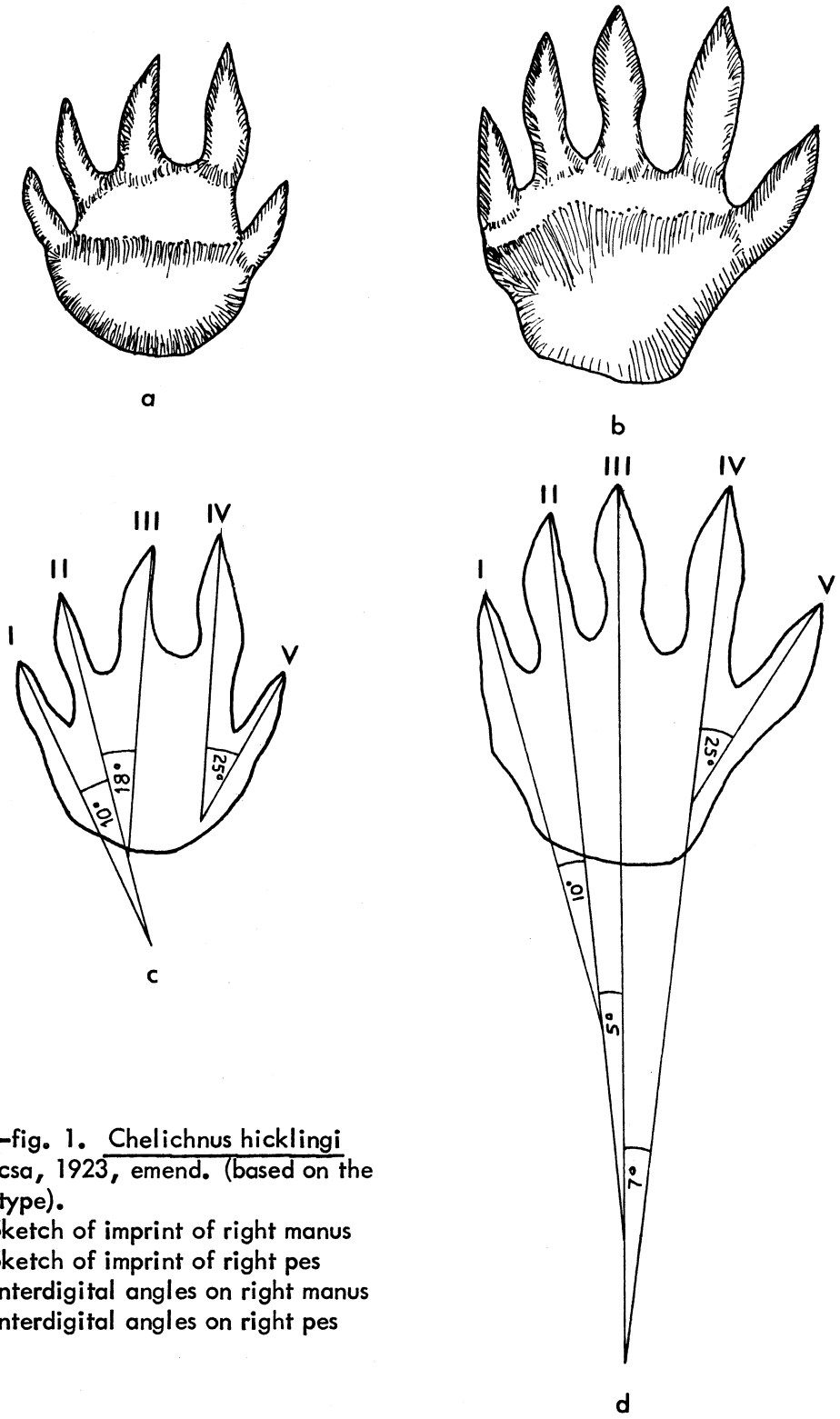
* Morrell (1966, pp. 215-216), in his biography of Shipman, was unaware that their description had ever been completed.



Text-fig. 1. Chelichnus hicklingi Nopcsa, 1923, emend. (based on the holotype).
(a) Sketch of imprint of right manus
(b) Sketch of imprint of right pes
(c) Interdigital angles on right manus
(c) Interdigital angles on right pes

of Germany, discussed the results contained in Hickling's 1909 paper and, unaware that Nopsca had already named them, noted (p. 50) the Mansfield specimens to be a new species of Chelichnus.

No further studies of the Mansfield footprints have been made in England. The shorter series still reposes in what is now the Manchester Museum; the longer series was affixed,by iron staples, to a wall outside the Geology Dept., in the buildings of the University College at Shakespeare Street, Nottingham. When the College moved to its new quarters at Highfields (now University Park) in 1928, the slab was overlooked and left behind.

Late in 1965, Mr. R.E.Elliott drew the author's attention to the slab of footprints, then located behind the main buildings of Nottingham Regional College of Technology. Although the identity of the slab was not then perceived,its interest was immediately obvious. The author therefore mentioned the matter to Professor W.D. Evans who immediately agreed that action should be taken to ensure the preservation of the slab. Permission to take it away was secured from the Principal of Nottingham Regional College of Technology, through the good offices of Mr. P.C. Stevenson.

Removal of the slab presented some problems, in view of its dimensions and the fact that it was situated at the end of a yard, alongside cycle sheds. However, this was safely carried out by a team consisting of Mr. R.D. Hendry, Mr. F. Bancroft, Mr. T. Foster, and the author; the slab was then taken by Land Rover to Nottingham University for cleaning and preservation. Although some deterioration had occurred during fifty years on an outside wall, the preservation remained remarkably good. The footprints are to be displayed in the new Department of Geology, at present under construction.

Taxonomy

As no description of the footprints has been published since 1909, and as Nopsca gave no diagnosis when he named the new species, it is considered appropriate that a diagnosis and description should be given, together with a synonymy, and that the nature of the animal forming the footprints should be discussed anew.

Ichnogenus Chelichnus Jardine, 1853

Diagnosis Prints of fore and hind feet similar in size. Toes with short claws, directed forwards. Sole of foot somewhat longer than the toes and carrying most weight (plantigrade): typically planted straight down, though in one species (C. ambiguus Jardine, 1853) the heel is raised slightly. Trackway broad, with short steps.

Type Species. Chelichnus duncani (Jardine, 1853)

Remarks. Jardine (1853) gave little in the way of a description; the diagnosis quoted above is based on Schmidt (1959, p. 50). Jardine originally believed, when naming the species, that the tracks were those of turtles (Chelonians); however, this is now considered almost certainly incorrect. Nopcsa (1923, p. 139) suggested instead that some of the tracks were made by Dicynodonts, an extinct Permo-Triassic group of Synapsid reptiles.

Chelichnus hicklingi Nopcsa, 1923, emend.
Plate 24 figs. 1 - 2. Text-fig. 1.

?1859 ------- Huxley, p. 456, pl. 14 figs. 4-5.
?1864 Ichnolites Harkness, p. 440.
?1884 Footprints, cast no. 4, Varty Smith, p. 480.

The series of footprints from Mansfield, Notts., described by Hickling (1906) and made holotype of the ichno-species Chelichnus hicklingi by Nopscsa (1923) 1. The whole slab. 2. Detail of footprints at bottom left. (Photo: J. Eyett).

1906 aff. Ichnium acrodactylum. Hickling, pp. 125-31, Text-figs. 1-2.
1909 Type Cl.7. Hickling, pp. 2-3, Pl. 1 figs. 1m, p, b.
1923 Chelichnus hicklingi n.sp. Nopcsa, p. 130.
1958 C. hicklingi Kuhn, pl. 5 figs. 30-1.
1959 Chelichnus n.sp. Schmidt, p. 50.

Diagnosis: Quadrupedal, plantigrade tracks, accompanied very occasionally by indications of tail drag. Manus and pes pentadactylate, with short claws; digits II - IV similar in length, digits I and V markedly shorter. Digit V opposed and thumb-like. Manus somewhat smaller than pes. Trackway broad; length of stride greater than width of trackway.

Holotype: Specimen PC 3128, collections of the Department of Geology, the University, Nottingham.

Topotype: Specimen L 6894, the Manchester Museum, Manchester.

Horizon: Mansfield Red Sandstone (a sandy intercalation within the Magnesian Limestone). Permian: Zechstein. Locality. Rock Valley Quarry, Mansfield, Notts.; grid reference SK 542613. (This quarry, situated off Rock Valley Road, has now been abandoned and largely filled in).

Dimensions of Holotype: Manus; length 8 cm. (= 3.1/6 inches), breadth from tip of digit I to tip of digit V, 6.1 cm. (= 2.3/8 inches). Pes; length 9.5 cm. (= 3.2/3 inches), breadth from tip of digit I to tip of digit V, 7 cm. (= 2.3/4 inches). Average width of trackway between middle of right and left manus, 19 cm. (= 7.1/2 inches). Average width of trackway between middle of right and left pes, 14.75 cm. (= 5.3/4 inches). Length of stride (i.e. distance between successive prints of the same foot) 21.75 cm. (= 8.3/4 inches).

Divarication of Digits: Manus; I - II, 10°; II-III, 18°; III-IV, almost parallel; IV-V, 25°. Pes: I-II, 10°; II-III, 5°; III-IV, 7°; IV-V, 25°. The angles are measured as shown in Text-fig. 1c-d; since the spread of the prints is seen to change across the slab as the hardness of the sand varies, and also as sand becomes packed onto the sole of the foot and shed, these measurements should be treated with caution (cf. for example the differing form of the imprint of the pes at the bottom and top of Pl. 24 fig. 2).

Remarks: Hickling (1906, p. 127) considered that there was evidence of a web between the digits. The present author could find no convincing evidence of such a feature, but the impressions are certainly now less perfect than they were at the time of discovery. On the other hand, the consistently pointed termination of the digits surely points to the presence of short, rather nail-like claws. Hickling apparently did not note the faint indications of tail-drag.

Whilst the angles of divarication of digits must be considered cautiously, the consistent opposition of digit V should be noted, as should the fact that digits III and IV approximate to parallelism. The presence of digit I of the manus was considered certain, but it is consistently poorly impressed and its form is difficult to determine. The author's conclusions regarding the outline of the prints are embodied in Text-figs. 1a-b; these drawings are recognisedly interpretative.

Discussion

From the examination of the Mansfield footprints, a number of conclusions may be drawn regarding the animal which made them. It was a quadruped, with hind-feet larger than fore-feet. The body weight was almost evenly distributed, but not quite so, since the hind-foot impressions are deeper and clearer. It walked with feet directed almost exactly forward; the main weight was taken on the sole of the foot, but some weight was taken by the digits, since they are clearly impressed. The outer side of the foot took more weight than the inner side. Presence of webbing between the toes was not confirmed.

The trackway was moderately broad and the stride short; it is not quite regular, suggesting a clumsy, perhaps a waddling, gait. The faint, irregular suggestions of tail drag (e.g. towards the top of Plate 24 fig. 1) suggest that the tail was carried clear of the ground and was probably relatively short. The length of the stride and the breadth of the trackway certainly do not suggest an especially large animal, perhaps with a body length of $2\frac{1}{2}$ - 3 feet. The clumsy gait suggests something not very active, certainly slow-moving.

Beyond this, one can only speculate. The maker of the footprints may have been an amphibian or a reptile - perhaps one of the Labyrinthodonts, large predatory amphibians, or perhaps a herbivorous reptile, a Pareiasaur or Dicynodent. In absence of knowledge of the number of phalanges forming the digits, we can get no further.

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William A. S. Sarjeant, B. Sc., Ph. D., F. G. S.,
Department of Geology,
The University, Nottingham

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