FOSSIL FOOTPRINTS FROM THE MIDDLE TRIASSIC OF NOTTINGHAMSHIRE AND THE MIDDLE JURASSIC OF YORKSHIRE

by

William Antony S. Sarjeant

Summary

A vertebrate footprint from the Keuper Waterstones of Mapperley Park, Nottingham, is redescribed and made the type for a new ichnospecies: ?Otozoum swinnertoni ichnosp. nov; it is considered to be probably the footprint of a bipedal saurischian dinosaur, perhaps a prosauropod. A vertebrate footprint from a new locality in the Middle Jurassic (Lower Deltaic Series) near Ravenscar, Yorkshire, is described; it is compared with a Lower Cretaceous ichnospecies, Satapliasaurus dsocenidzei Gabouniya, but probably represents an ichnospecies as yet undescribed. It is considered to be the footprint of an ornithopod dinosaur.

Introduction

In an earlier paper redescribing fossil vertebrate footprints collected by the late Professor Henry H. Swinnerton (Sarjeant, 1967), it was noted that no footprints according with Swinnerton's "type A" had been located. A specimen considered by the author to accord with this type of track has now been found; it is here described and illustrated, and its taxonomic assignation is considered.

In addition, a vertebrate footprint from a new locality near Ravenscar, Yorkshire, is described; this was collected during the summer of 1969 by a Nottingham University student, Robert D. Boutell. It is compared with specimens recorded earlier from the "Inferior Oolite" of Saltwick, Yorkshire.

1. FOOTPRINT FROM THE MIDDLE TRIASSIC OF NOTTINGHAMSHIRE

In 1912, Swinnerton recorded the track of a vertebrate from the Keuper Waterstones of Mapperley Park, which he described in the following terms (pp.. 66-7):-

> "Its foot was nine inches long and had at least four toes with a span of five inches. The toes were short as compared with the sole and were widely spread. The presence of the impression of the sole as well as of the toes indicates that it walked, as a man does, upon the flat of the foot, and was therefore plantigrade. The same print is repeated a yard in front, and halfway between but not in quite the same line is an imperfect impression of the other hind foot. There was no trace of the impression of the front feet, so that it evidently progressed easily on its hind feet alone.

This conclusion is substantiated by the discovery on another slab, and in association with a print made by a closely similar if not identical animal, of the imprint of a fore foot. This was only two and a half inches long with a span of three inches. The hind feet were therefore much larger than the fore feet and evidently carried the major portion of the weight of the body. The length of the stride and the size of the feet indicate an animal about four feet high."

In an earlier restudy of Swinnerton's material (Sarjeant, 1967), footprints of this type (his Type A) were not located. A large single print of a hindfoot, considered to be the right hind foot, has since come to light, labelled as from this locality and of the correct dimensions. It is described below:-

Class REPTILIA

Order SAURISCHIA

Ichnofamily Gigandipodidae Lull 1904

Ichnogenus OTOZOUM Hitchcock 1847

1847 Otozoum HITCHCOCK, p. 34.
1858 Otozoum Hitchcock. HITCHCOCK, p. 123.
1904 Otozoum Hitchcock. LULL, p. 513.
1915 Otozoum Hitchcock. LULL, p. 122.
1953 Otozoum Hitchcock. LULL, pp. 187-8.
1954 Otozoum Hitchcock. BAIRD, p. 185.
1958 Otozoum Hitchcock. KUHN, p. 23.
1959 Otozoum Hitchcock. SCHMIDT, pp. 21, 107.
1963 Otozoum Hitchcock. KUHN, p. 85.

Diagnosis. Bipedal. Manus rarely present in the trackway. Pes plantigrade, functionally tetradactyl, hallux non-rotated. Digits broad, with well marked phalangeal pads; claws more or less rounded. Manus apparently pentadactyl, relatively small. Occasional trail trace.

Type Species. Otozoum moodii Hitchcock, 1847, Upper Triassic, Connecticut, U.S.A. (Text-fig. 3).

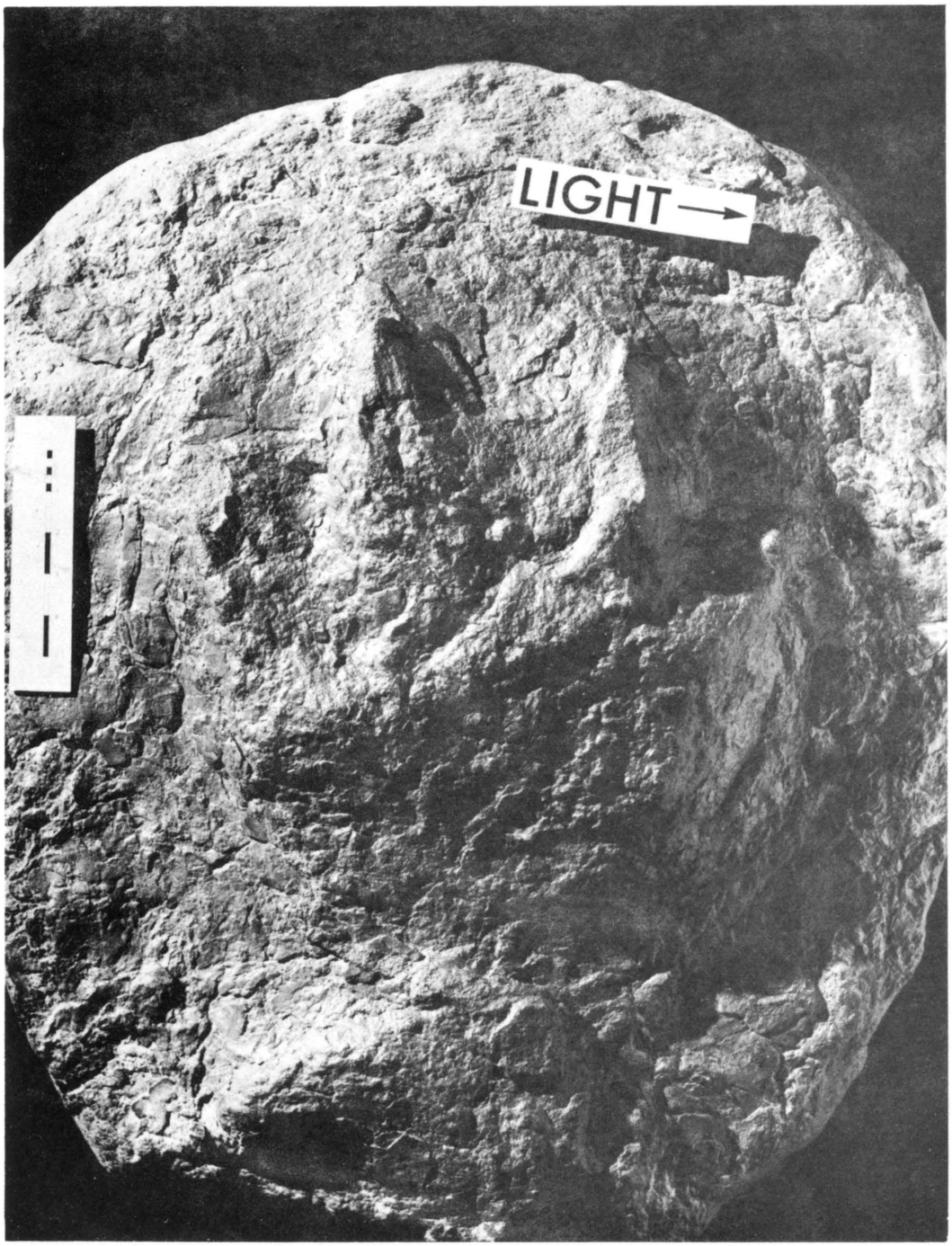
? Otozoum swinnertoni ichnosp. nov.

Plate 20, Text-figures 1, 2B.

1912. Vertebrate tracks, type A. SWINNERTON, pp. 66-7, pl. 4 fig. 3.
?1949 Vertebrate footprint. CHARLES, p. 10, text-fig. 1.

Diagnosis. Pes, considered to be of a bipedal reptile. Plantigrade, with the digits and front and hind parts of the sole deeply impressed, the central part of the sole not being impressed. Four digits (I-IV) are represented, the first being reduced. The fifth digit is not impressed (either non-functional or lacking). The digits are not markedly divergent; the phalangeal pads are poorly marked and the claws are not very acute.

Supplementary Notes. The author believes that this imprint, which is certainly from the same locality and exhibits comparable dimensions, corresponds to Swinnerton's "type A" (1912). From his description (quoted earlier), this was the track of a plantigrade animal; his illustration (1912, pl. 4 fig. 3) shows that the digits and front and hind parts of the sole of the pes were impressed, but that the central part of the sole was not impressed. Unfortunately, he illustrates


LIGHT

the mould, not the cast, making direct comparison impossible; unfortunately also, the photograph is over-reduced and of poor quality. For these reasons, certain identification is impossible and the identity of his "type A" with the specimen here figured cannot be established beyond doubt. If it is accepted, the following additional information can be supplied:-

> Typically bipedal, sometimes quadrupedal. Manus impression about one-third the size of that of the pes, with four (or five?) digits. Length of stride in bipedal gait about four times the length of the pes.

Holotype. Specimen PC4238 (cast of pes), collections of the Department of Geology, University of Nottingham. Type locality and horizon. Keuper Waterstones (L. Ladinian; Middle Triassic), Mapperley Park, Nottingham.

Dimensions. Pes (holotype); maximum length 215 mm., maximum breadth 145 mm., length of digit II c. 50 mm., digit III c. 63 mm., digit IV c. 50 mm., digit V 24 mm. Interdigital angles: I - II, 6.5°, II - III, 8°, III - IV 8° (see Text-fig. 2B).

Supplementary Measurements. Manus not available for measurement; according to Swinnerton (1912, p.67) length c.62.5 mm., breadth c. 71.5 mm. Length of stride in bipedal gait (according to Swinnerton, 1912, p.66) c. 915 mm.

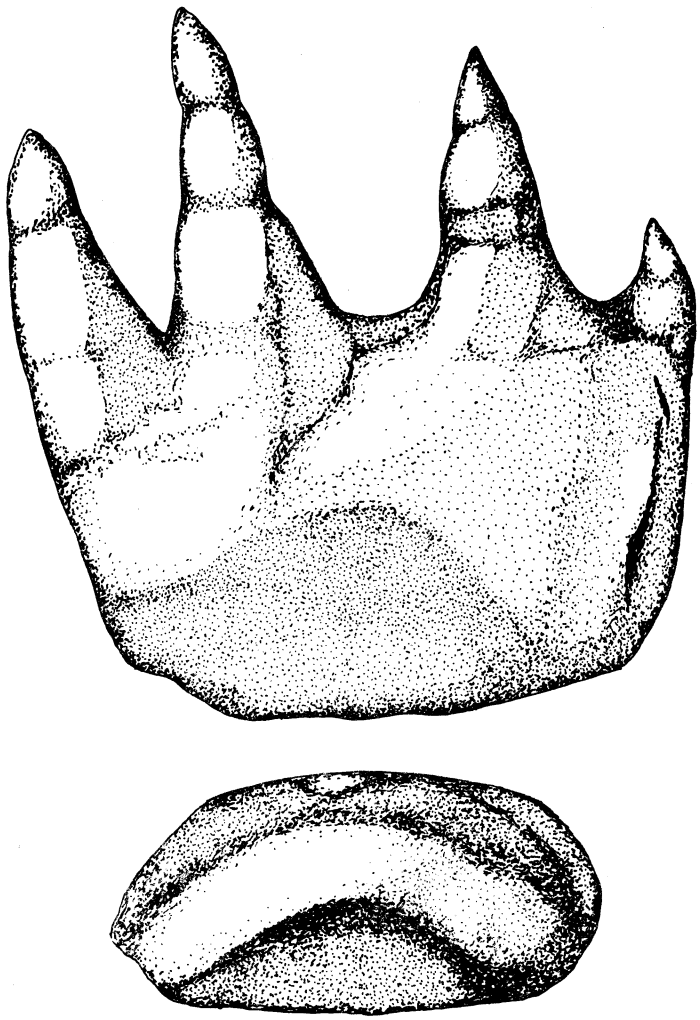
Derivation of Names. After the late Professor Henry Hurd Swinnerton, a pioneer of footprint study in Nottingham and Derbyshire.

Remarks. So far as has been determined from an extended examination of footprint literature, the imprint here recorded represents an undescribed type, without close morphological similarity to any described ichnospecies (bipedal or quadrupedal). For this reason, a new name is confidently assigned to it.

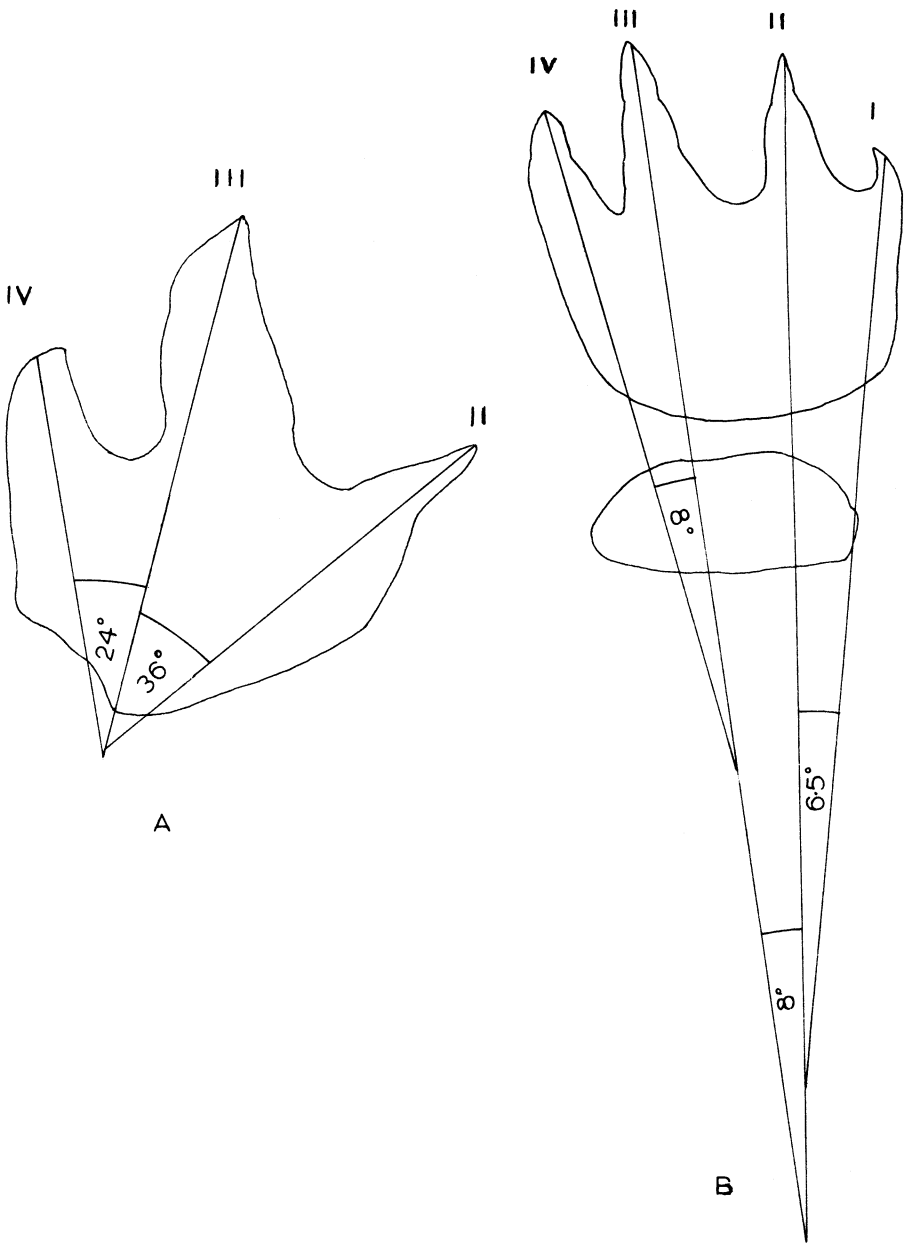
Although I recognise that final confirmation is impossible, I believe that this print is identical with "type A" of Swinnerton. If this is accepted, then these are the tracks of a basically bipedal and plantigrade, occasionally quadrupedal animal, with manus much smaller than pes and with pes blunt-clawed, the sole being clearly impressed. On these bases, it is attributable to the ichnogenus Otozoum, from which it differs only in that the phalangeal pads are poorly marked.

Swinnerton commented on the absence of claws (1912, p.67) and believed these to be amphibian tracks: however, his photograph of a mould (ibid., pl. IV fig. 3) indicates that claws were indeed present and his conclusion, that the gait of this creature was normally bipedal, scarcely favours an amphibian affinity. The marked difference in size of manus and pes strongly suggests a diapsid reptile. It should be noted, however, that the disparity in size between manus and pes is less great than the measurements suggest, for the sole of the pes is impressed and included in the length, whereas the palm of the manus is not. The rather blunt claw impressions do not suggest a carnivorous reptile, since in most bipedal carnivores the hind feet were very definitely "weapons of offense"; they suggest rather an omnivorous or a herbivorous mode of life.

Lull (1915, 1953) concluded that the Otozoum footprints were those of a prosauropod, a group on the evolutionary line that was to lead to the giant quadrupedal, herbivorous sauropod reptiles of the Jurassic. The typical prosauropods, such as Plateosaurus, are known to be both bipedal and quadrupedal at different times and, when bipedal, to be plantigrade. In such forms, the manus and pes are not very markedly different in size. In Yaleosaurus, which is considered to be an early prosauropod, the size difference is about 1 to 2. Allowing for the absence of a



TEXT-FIG. 1 ? Otozoum swinnertoni Sarjeant, ichnosp.nov.; pes. Keuper Waterstones (M. Triassic), Mapperley, Nottingham. (For dimensions, see text).



TEXT-FIG. 2 Sketches of footprints, showing how the angles of divarication of the digits were taken. A. Satapliasaurus cf. dsotsonidzei Gabouniya. B. ?Otozoum swinnertoni Sarjeant, ichnosp. nov.

palm imprint, the prints here described would suggest an animal whose limbs were of comparable relative proportions (an attempt at a reconstruction is made in Text-fig. 3A). It thus seems feasible, though by no means certain, that ?Otozoum swinnertoni ichnosp.nov. represents the track of an early prosauropod; however, it should be noted that skeletal remains of prosauropods have been only doubtfully recorded to date as early in the Triassic as the Ladinian.

If Lull's conclusion on affinity is accepted, then his numbering of the digits, which he designates II-V, requires revision; in the prosauropods, it is the fifth digit of the pes, not the first, that is reduced and non-functional. The digits are accordingly here numbered I-IV. (See Text-fig. 2B).

Only one form at all comparable to ? Otozoum swinnertoni ichnosp.nov. has been previously figured, to the author's knowledge. This is an unnamed imprint from the Triassic of Provence, France, figured by Charles (1949, text-fig. 1): it accords closely with the Nottingham print in the form of the digits and front part of the sole, but the diagram does not show an impression of the hind part of the sole. It thus may be the footprint of a digitigrade biped, perhaps related to this new ichnospecies, perhaps not.

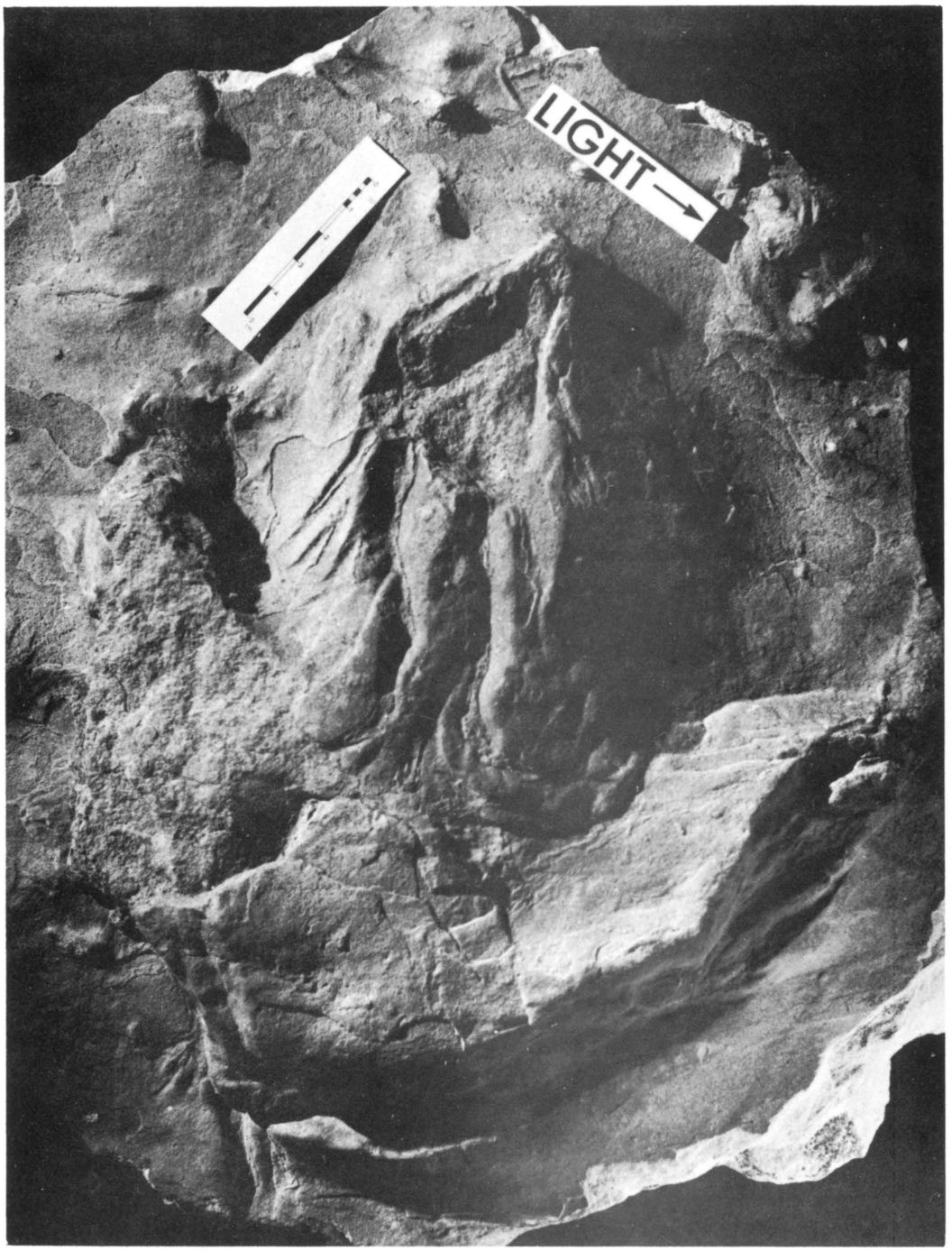
II FOOTPRINT FROM THE MIDDLE JURASSIC OF YORKSHIRE

Footprints from the Middle Jurassic of northeast Yorkshire were first described by Harold Brodrick (1907), who found casts of three-toed prints in two fallen blocks of sandstone on the foreshore at Saltwick, Yorkshire and described them in a brief article arrestingly entitled "A Find!!! " This article was noted by "T.S." (probably Thomas Sheppard) in "The Naturalist" (1908, pp. 300-1), who commented caustically that its title savoured "of a Patent Medicine advertisement"; he concluded, from an examination of the specimens, that the blocks were derived from the Estuarine Series. Brodrick wrote a follow-up note on his original find (1908 a) for the British Association, then reported the finding of a further block, apparently from the same sandstone, with some thirteen prints of a number of different types (1908 b). He gave a definitive account of these footprints in a longer article published in 1909, in which some 17 prints are depicted, of at least three basic types. In 1915, Fox-Strangways and Barrow reported that the position of the footprint bed within the Lower Estuarine Series had been identified by P.F. Kendall, and gave details of its position (p.31); they also reported the finding of footprints in the Upper Estuarine Series near Burniston Fields, about half a mile south of Long Nab (p. 44).

The footprint here described was collected from the disused Peak Alum Quarries (NZ/45. 969 016), near Ravenscar, Yorkshire. It was found in a loose block of material from the base of the Lower Deltaic Series (ex: Lower Estuarine Series), considered to be derived from a stratum about 21 feet above the top of the Dogger.

Jurassic footprints have attracted only slight attention from palaeoichnologists; the number of works dealing with them is slender, contrasting strikingly with the vast literature on Triassic tracks. (Kuhn, 1958, pp. 25-6, lists only about fourteen references to Jurassic tracks; though his list is certainly incomplete, published references to date probably do not exceed fifty). For this reason, it was considered desirable to give a full description and illustration of the footprint.

Plate 21



Class REPTILIA

Order ORNITHISCHIA

Ichnofamily Anomoepodidae Lull 1904

Ichnogenus SATAPLIASAURUS Gabouniya 1951

1951 Satapliasaurus GABOUNIYA, p. 917.
1955 Satapliasaurus Gab. PIVETEAU, p. 900.
1955 Satapliasaurus Gab. LESSERTISSEUR, p. 115.
1958 Satapliasaurus Gab. KUHN, p. 28.
1963 Satapliasaurus Gab. KUHN, p. 107.

Diagnosis. "Small, slender, functionally biped, digitigrade dinosaurs. The pes has three functioning digits, equipped with sharp claws. The digits are rather close-set, giving the pes a narrow shape. The weakly developed first digit left little trace in the footprint. The tail balanced, or lightly touched the ground when walking". (Transl.)

Remarks. The generic diagnosis presents several points of difficulty. Of three species originally placed in this genus by its author, only S. tschabukianii (the type species) shows indication of the presence of the first digit and can be said to have a narrow-shaped pes. In the other two species (S. dsocenidzei and S. kandelakii), only three digits are represented and, in the latter especially, the pes has quite a broad spread. The size can scarcely be said to be "small" when the quoted footprint lengths range from 220 to 250 mm. - small for a dinosaur, maybe, but many footprints of diapsid reptiles are very much smaller! A revision of the generic diagnosis, possibly involving removal of the two latter ichnospecies to a separate ichnogenus, appears urgently necessary: a clarification of the features distinguishing Satapliasaurus from the older ichnogenus Anomoepus Hitchcock, 1848, would also be helpful.

Satapliasaurus dsocenidzei Gabouniya 1951
Text-fig. 5b

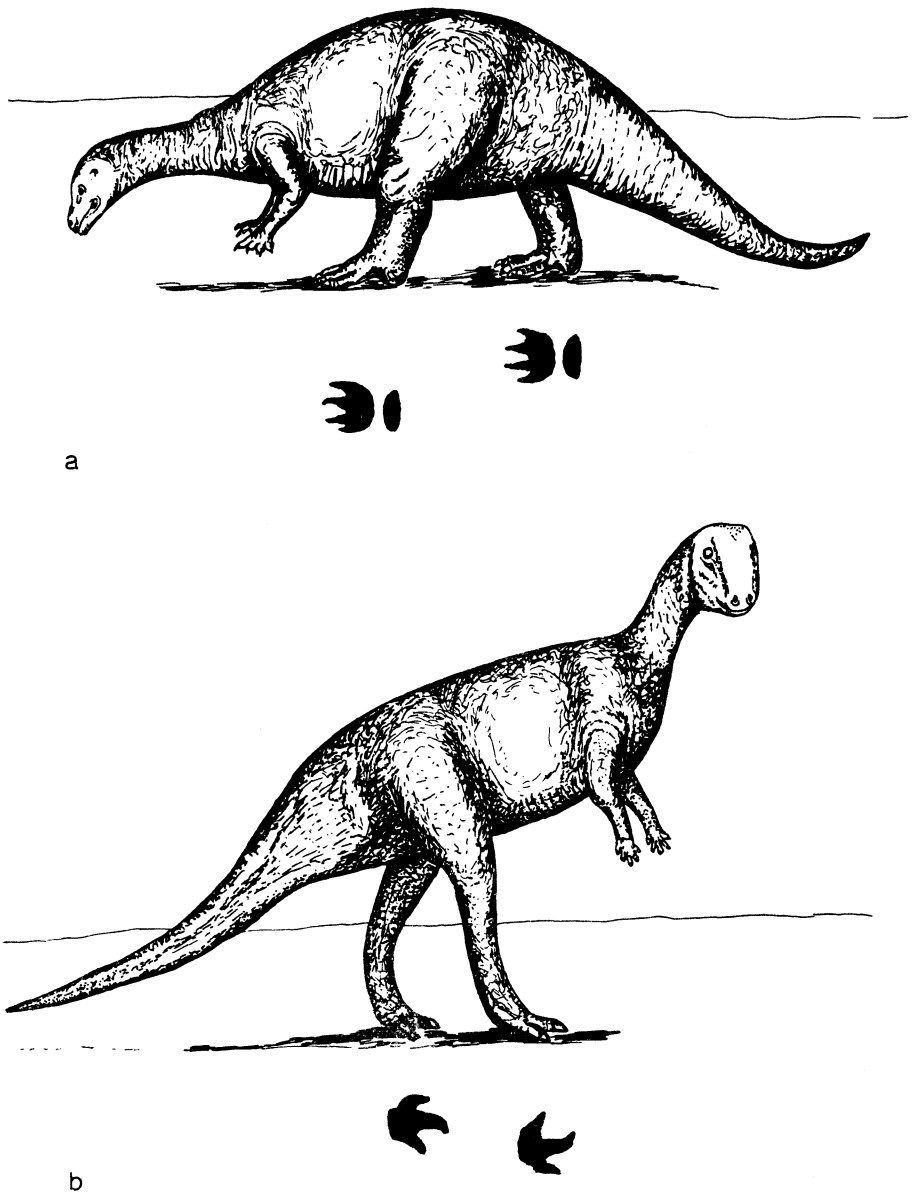
1951 Satapliasaurus dsocenidzei GABOUNIYA, p. 918, Text-fig. 1c.
1952 Unnamed footprints GABOUNIYA, p. 122, text-fig. 2.
1958 S. dsocenidzei Gab. KUHN, p. 28, pl. 12, fig. 14.
1963 S. dsocenidzei Gab. KUHN, p. 107.

Diagnosis. "Small, biped, digitigrade dinosaurs. The pes has a narrow shape and comparatively short digits, with strongly developed claws. On the imprint of the pes is a well-marked footprint (of the post-phalangeal section of the "heel"). Prints of the first digit and tail are lacking.

"Length of footprint 220 mm. Width of footprint 155 mm. Length of pace 600 mm!" (Transl.)

Satapliasaurus cf. dsocenidzei Gabouniya. 1951
Plate 21, Text-figs. 2a, 4

1899 Saurischia div., gen. indet. MARSH, p. 231, fig. 1a, pl. V.
?1907 Footprint, type 1. BRODRICK, p. 8.
?1908 Footprint, type 2. "T.S.", p. 301, text-fig. 1.
?1908a Footprint, type 1. BRODRICK, p. 707.
1908b Footprints, type F and ?G. BRODRICK, p. 7.
1909 Footprints, type F, ?G. BRODRICK, pp. 330, 333-4, text-figs. F, G, pl. III.



TEXT-FIG. 3 The probable nature of the track-makers. a. A bipedal diapsid reptile, possibly an early prosauropod related to Yaleosaurus. (Redrawn after Lull, 1953). b. An ornithopod reptile, comparable with Camptosaurus. (Based on a restoration by J.C. Germann).

Description. Footprint of a bipedal digitigrade reptile with three functional digits (II - IV), spreading quite widely. Digits broad, with blunt claws; phalangeal pads not distinguishable. Digit III is longest; digits II and IV are of similar length. Front part of sole impressed quite deeply: back part apparently raised well clear of the ground, since it is not indicated at all.

The specimen is considered to represent the right pes and the digits are numbered accordingly.

Figured Specimen. Specimen PC 4237 (cast of pes), collections of the Department of Geology, University of Nottingham. Type locality and Horizon. Lower Deltaic Series c.21 feet above base (U.Aalenian: Middle Jurassic), Peak Alum Quarries, near Ravenscar, Yorkshire.

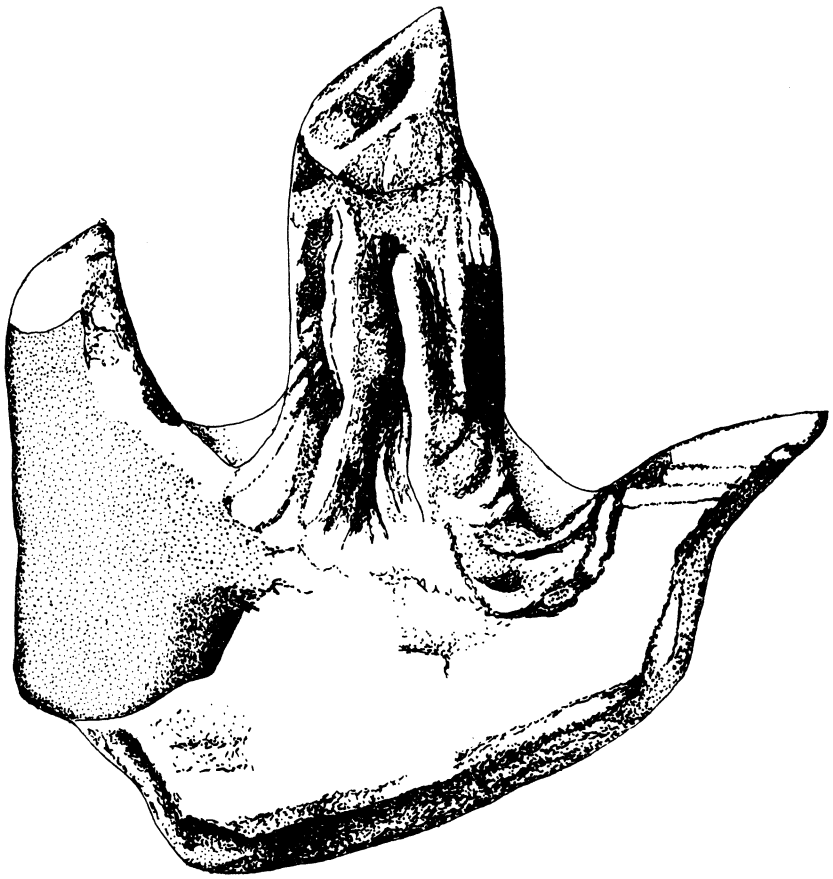
Dimensions. Pes (figured specimen): maximum length 240 mm., maximum breadth c.230 mm., length of digit II 70 mm., digit III 130 mm., digit IV 65 mm., interdigital angles II-III 36°, III-IV 24° (see Text-fig. 2a).

Discussion. In his earliest reports of the Saltwick footprints, Brodrick (1907, 1908a) gave no figures. The photograph included in the note by "T.S." (1908, Text-fig. 1) suggests a similarity of one of the prints with the type here described; the dimensions are comparable (length $8\frac{1}{2}$ inches) but the print appears more elongate. In his fuller account, Brodrick (1909, p. 334, pl. III) names this as "Type P": his figure again suggests some differences from the type here described, the print being more elongate and with longer digits.

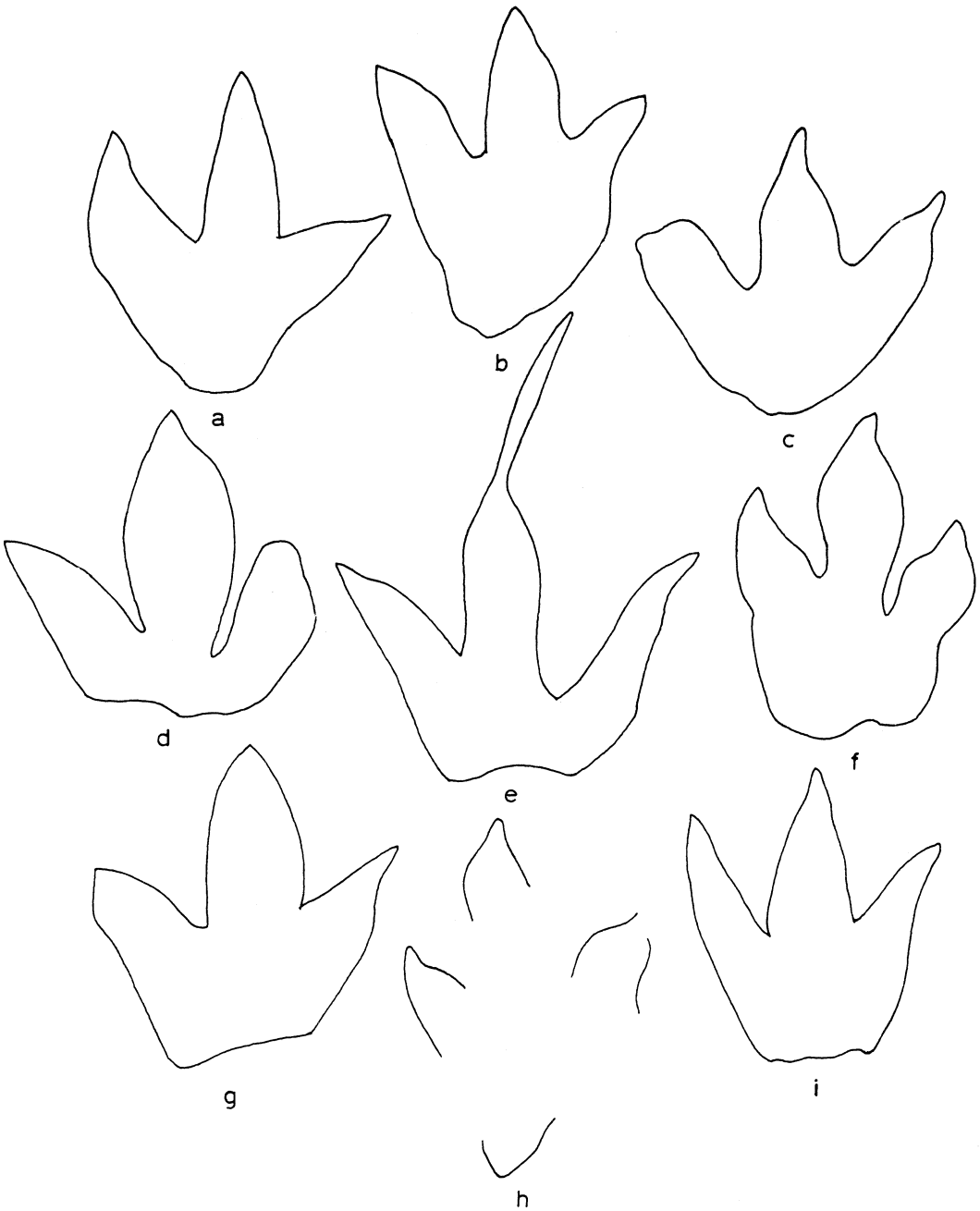
In contrast, one print on the second slab found by Brodrick (1908b p.7: 1909, p.333, text-fig. F; herein, Text-fig. 5d) appears identical in morphology with that here described, though it is markedly smaller in size (length 170 mm., breadth 180 mm.). A second print (Brodrick, 1908b p.7; 1909 p. 330, text-fig. G; herein, Text-fig. 5e) is comparable in general morphology, but shows an immense elongation of the central digit which may well represent a superimposed tail-drag mark; its size appears similar, but the measurements quoted are not helpful. A re-examination of the type material (lodged in Whitby Museum, Yorkshire) will be needful before these comparisons can be confirmed or otherwise.

Footprints apparently identical with the one here described were recorded by Marsh (1899) from the Upper Jurassic of the Black Hills, Dakota (Text-fig. 5g). Footprints from the Lower Lias of La Vendée, France, described as Saltopoides igalensis ichnogen. et sp. nov. (Lapparent & Montenat, 1967), have a comparable outline, but are somewhat more elongate and only the tips of the digits and heel are impressed (Text-fig. 5h). Much more closely comparable are two species described from the Lower Cretaceous of Russia, described by Gabouniya (1951). In overall shape, Satapliasaurus kandelakii Gabouniya is closely similar: however, the digits bear narrow, sharp claws (see Text-fig. 5c). A second ichnospecies, S.dsocenidzei, is similar in general shape and has less markedly acute claws than S.kandelakii (see Text-fig. 5b). However, it differs in that the hind part of the heel is clearly impressed. The Yorkshire prints probably represent an undescribed ichnospecies; until further specimens become available, however, it is proposed that they be named Satapliasaurus cf. dzocenidzei Gabouniya.

Other comparable ichnospecies include ?Coelurosaurichnus schlehenbergensis (Rehnelt, 1950) Kuhn, 1958, from the Triassic of Germany, which differs in that the digits show a marked terminal thickening (Text-fig. 5f); Coelurosaurichnus moeni Beurlen, 1950, also from the German Triassic, differing in that the digits are more equal in length (Text-fig. 5i); Sinoichnites youngi Kuhn, 1958, from the Jurassic of China, differing in that its digits lack claws; unnamed footprints from the Cretaceous of Algeria (Bellair & Lapparent, 1949, pl. 5), closely similar but with lateral digits slightly more angular in outline and size markedly smaller (Text-fig. 5a); and Gypsichnites pacensis Sternberg, 1932, from the Lower Cretaceous of Canada, differing in its larger size, more rounded heel and broader central digit III.



TEXT-FIG. 4 Satapliasaurus c.f. dsotsenidzei Gabouniya; pes. Lower Deltaic Series (M. Jurassic), nr. Ravenscar, Yorks. (For dimensions, see text).



TEXT-FIG. 5. Outline drawings, at approximately constant size, of some Mesozoic tridactyl footprints comparable with Satapliasaurus cf. dsotsenidzei.

a. Unnamed footprint from the Cretaceous of Algeria (Bellair and Lapparent, 1949).
b. Satapliasaurus dsotsenidzei Gabouniya 1951. L. Cretaceous, Georgia, U.S.S.R.
c. Satapliasaurus kandelakii Gabouniya, 1951. L. Cretaceous, Georgia, U.S.S.R.
d. Footprint type F, from the Middle Jurassic of Yorkshire (Brodrick, 1909).
e. Footprint type G, from the Middle Jurassic of Yorkshire (Brodrick, 1909).
f. ?Coelurosaurichnus schkehenbergensis (Rehnelt, 1950) Kuhn, 1958, Triassic, Germany.
g. Unnamed footprint U. Jurassic, Dakota, U.S.A. (Marsh, 1899).
h. Saltopoides igalensis Lapparent & Montenat, 1967, Lower Jurassic, France.
i. Coelurosaurichnus moeni Beurlen, 1950, Triassic Germany.

This footprint is considered to be that of a bipedal, herbivorous ornithopod dinosaur (see Text-fig. 3b). This interpretation differs from that of Gabouniya, who considered her prints to be those of carnivorous dinosaurs; it is based simply on the relatively blunt character of the claws, an important weapon of offense in carnivorous dinosaurs and therefore usually sharp and pronounced. Ornithopod footprints have long been known from the Upper Triassic: and recently, skeletal remains have also been discovered. In the Jurassic, remains of ornithopods are only sparsely known; much is still to be learned about the early history of this group of reptiles.

Acknowledgements

The author acknowledges with thanks the generosity of Mr. R.D. Boutell, in presenting the Jurassic footprint to the University of Nottingham; helpful discussions with Mr. A.J. Rundle; photographic assistance from Mr. B.M. Logan; translation of relevant Russian passages by Mr. Stephen Henley; and the critical reading of the manuscript by Mr. A.M. Honeyman. Dr. Hartmut Haubold, of the Martin-Luther-Universität, Halle, Germany (D.D.R.) courteously permitted reading of his unpublished manuscript on Triassic footprint classification.

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

REFERENCES

BAIRD, D. 1954. Chirotherium lulli, a Pseudosuchian reptile from New Jersey. Bull. Mus. Comp. Zool. Harvard, Vol. III no. 4, pp. 165-92, pls. 1-2, text-figs. 1-3.

BELLAIR, P. & LAPPARENT, A.DE 1948. Le Crétacé et les empreintes de pas de Dinosauriens d'Amoura (Algérie). Bull. Soc. Hist. Nat. Afrique Nord, Vol. 39 nos. 7-8, pp. 168-75, pls. 1-5.

BEURLEN, K. 1950. Neue Fährtenfunde aus der Fränkischen Trias. N. Jb. Geol. Paläont., Mh., pp. 308-20, 4 figs.

BRODRICK, H. 1907. A find!!! Whitby Lit. and Phil. Soc., 85th Rep., pp. 8-9.

1908a Note on casts of Dinosaurian footprints in the Lower Oolite at Whitby. Rep. Brit. Assoc. Adv. Sci., Dublin Meeting (1908), p. 707.

1908b Note of further footprint casts found in the Inferior Oolite at Saltwick. Whitby Lit. & Phil. Soc., 86th Rep., pp. 6-7.

1909. Note on footprint casts from the Inferior Oolite near Whitby, Yorkshire. Proc. Liverpool Geol. Soc., Vol. 10, pp. 327-35, pls. 3-4, 8 text-figs.

CHARLES, R.P. 1949. Note sur la présence de Chirotherium près de Sollies - Ville (Var). C.R. Séances Soc. Etud. Paléont. Paleoethnogr. Provence, Vol. II pp. 10-12, text-figs. 1-3.

FOX-STRANGWAYS, C. & BARROW, G. 1915. The Geology of the country between Whitby and Scarborough. 2nd Edition. Mem. Geol. Surv., 144 pp.

GABOUNIYA, L.K. 1951. O sledakh dinozavrov iz Nizhnemyelovikh otlozheniy Zapadnoy Gruzii. (Dinosaur footprints from the Lower Cretaceous of Georgia). Dokl.Akad. Nauk S.S.S.R., Vol. 81, pp. 917-9, text-figs. 1-2.

1952. Sledi dinozavrov na gorye Sataplia. (Dinosaur footprints from Mt. Sataplia). Priroda Akad. Nauk S.S.S.R., Vol. 51, pp. 122-3, text-figs. 1-7.

HITCHCOCK, E. 1847. Description of two species of fossil footmarks found in Massachusetts and Connecticut, or of the animals that made them. Amer. J. Sci., ser. 2, Vol. 4., pp. 46-57, Figs. 1-3.

1858. Ichnology of New England. Boston, Mass.; White.220 pp., 60 pl.

KUHN, O., 1958. Die Fährten der vorzeitlichen Amphibien und Reptilien. Bamberg: Verlagshaus Meisenbach. 64 pp., 13 pl.

1963. Ichnia tetrapodorum. Pt. 101 of Fossilium Catalogus 1. Animalia. s'Gravenhage: Junk, 176 pp., 12 pl.

LAPPARENT, A. DE, & MONTENAT, C.
1967. Les empreintes de pas de reptiles de l'Infralias du Veillon (Vendée). Mem. Soc. Géol. Fr., n.s., Vol. 46 pt. 2 (Mém. no. 107), pp. 1-44, pl. 1-13.

LESSERTISSEUR, J. 1955. Traces fossiles d'activité animale et leur signification paléobiologique. Mem. Soc. Géol. Fr., n.s., Vol. 34 no. 4, pp. 1-150, pl. 14-24, text-figs. 1-68.

LULL, R.S. 1904. Fossil footprints of the Jura-Trias of North America. Mem. Boston Soc. Nat. Hist., Vol. 5 pp. 461-557, pl. 72, text-figs. 1-34.

1915. Triassic life of the Connecticut Valley. Bull. Connecticut Geol. Nat. Hist. Surv. no. 24 pp. 1-285, pls. 1-12, text-figs. 1-126.

1953. Triassic life of the Connecticut Valley. Bull. Connecticut Geol. Nat. Hist. Surv., no. 81, pp. 1-336, pls. 1-12, text-figs. 1-168.

MARSH, O.C. 1899. Footprints of Jurassic dinosaurs. Amer. J. Sci. Ser. 4, Vol. 7, pp. 227-32, pl. 5, text-figs. 1-3.

PIVETEAU, J. 1955. Traité de Paléontologie. vol. 5. Paris: Masson, 1113 pp.

REHNELT, K. 1950. Ein Beitrag über Fährtenspuren im unteren Gipskeuper von Bayreuth. Ber. Naturforsch. Ges. Bayreuth, Vol. 6., pp. 27-36, pls. 1-2.

SARJEANT, W.A.S. 1967. Fossil footprints from the Middle Triassic of Nottinghamshire and Derbyshire. Mercian Geologist, vol. 2 No. 3, pp. 327-41, pls. 13-16, text-figs. 1-4.

SCHMIDT, H. 1959. Die Cornberger Fährten im Rahmen der Vierfüssler Entwicklung. Abh. Hess.Landesanst. Bodenforsch., Vol. 28, pp. 1-137, pls. 1-9, text-figs. 1-57.

"T.S." (SHEPPARD, T.) 1908. Footprints in a Yorkshire sandstone. The Naturalist, August 1908, pp. 300-1, text-figs. 1-2.

STERNBERG, C.M. 1932. Dinosaur tracks from Peace River, British Columbia. Ann. Rep. Nat. Mus. Canada (1930) pp. 59-75, pls. 1-5, text-figs. 1-9.

SWINNERTON, H.H. 1912. The palmistry of the rocks. Trans. Nottingham Naturalists' Soc. (1911-12) pp. 65-8, pls. 3-5.