

FOSSIL VERTEBRATE AND INVERTEBRATE TRACKS FROM BOREHOLES THROUGH
THE BUNTER SERIES (TRIASSIC) OF WORCESTERSHIRE

by

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Summary

Vertebrate and invertebrate tracks are recorded with certainty from the English Bunter for the first time, from two boreholes through the Upper Mottled Sandstone and Bunter Pebble Beds of Worcestershire. Footprints of eight different types of small reptiles are described: the reptiles which made them are considered to include pseudosuchians, coelurosaurs, rhynchocephalians or early lizards, and (possibly) cotylosaurs. Running tracks of insects, morphologically identical with forms previously recorded from the Keuper of Cheshire and with *Permichnium völkerei* Guthorl, from the German Permian, are also recorded. The possible use of vertebrate footprints as stratigraphic indices in the British Triassic is briefly discussed.

Introduction

It is, at first sight, remarkable that, whilst there has been a long list of records of fossil vertebrate footprints from the English Keuper (cf. Swinton, 1960), no definite records from the Bunter have yet been published. R. Harkness (1850) recorded tracks in what he described as a Bunter sandstone from quarries at Weston Point, Cheshire; however, this stratigraphic assignation is suspect, since vertebrate tracks are abundant in the Keuper of that vicinity but are not otherwise known from the Bunter. (The type material is lost).

The lack of footprint records from the Bunter, however, becomes comprehensible when the character of the sediments is considered. Footprints from the Keuper Series are preserved as natural casts, in compact sandstone, of prints that were made on a drying-out mud-flat; in consequence, the quality of the casts is often extremely high, even the pattern of scales being often determinable. The lithology of the sandstones and conglomerates making up the Bunter series is much less coherent: they are unsuitable for quarrying, and the discovery and collection of footprints from natural exposures or road cuttings is virtually impossible. Even the footprints described below, which were collected from boreholes, are often indistinct. Furthermore they are far smaller and less easily recognisable than most of the forms described hitherto from the Permian and Triassic and are correspondingly more difficult to study and compare.

All examples described below, were found in 18 inch diameter borehole cores that were searched by the senior author, in most cases shortly after extraction and before the cores had been exposed to the weather for more than a short time, and in some cases from cores that had been freshly split open.

Within the last few years, a series of boreholes has been sunk by the East Worcestershire Waterworks Co. at their pumping station at Bellington, three miles east of Kidderminster (SO 877 768). These have yielded a very complete and exceptionally thick (1185 feet) section through the

the whole of the Triassic part of the Bunter Formation (the Bunter Pebble Beds and the Upper Mottled Sandstone) down into the Dune Sandstone, which is now regarded as Permian (Wills, 1948, 1956). In place of the usual Shingle Beds at the bottom of the Bunter Pebble Beds, a thick breccia-conglomerate occurs. This has a unique pebble composition indicating a derivation from a catchment with outcrops of Cambrian quartzite and of hitherto-unknown volcanic rocks and of a dolomitic limestone, also of uncertain age and provenance. In addition there is a sprinkling of typical shingle pebbles of the basal Bunter Pebble Beds.

The whole Triassic Bunter succession at Bellington consists of five 'desert cyclothem's', each beginning with a suite of coarser sediments (a "a floods-sequence") that is followed by a suite of finer ones (a "drought-sequence"), the latter exhibiting signs of desiccation. In four out of the five droughts-sequences, footprints and other trace-fossils have been found. This is the first definite record of footprints from the British Bunter.

Vertebrate footprints were found to be present in Bellington borehole No.4 in the Upper Mottled Sandstone at depths of 229 feet and 625 feet, and in the Bunter Pebble Beds at 733 feet, c. 1,000 feet 1,005 feet and 1,152 feet: invertebrate tracks (*Permichnium völckeri* Guthorl) were recognised at about 1,000 feet depth. Vertebrate footprints were present in Bellington no. 3 borehole at 540 feet depth (together with '*Planolites*') in the Upper Mottled Sandstone, and, together with invertebrate trails, at 886 feet depth on a ripple-marked surface in the Bunter pebble Beds.

A full account of the geology of the Bellington Boreholes is being published elsewhere (Wills, 1970 and in press).

Systematics

All specimens described in this paper are lodged in the Department of Geology, University of Birmingham: specimen numbers are quoted in plate and figure captions.

PHYLUM CHORDATA

SUBPHYLUM VERTEBRATA

Class Reptilia

Order Thecodontia

Suborder Pseudosuchia

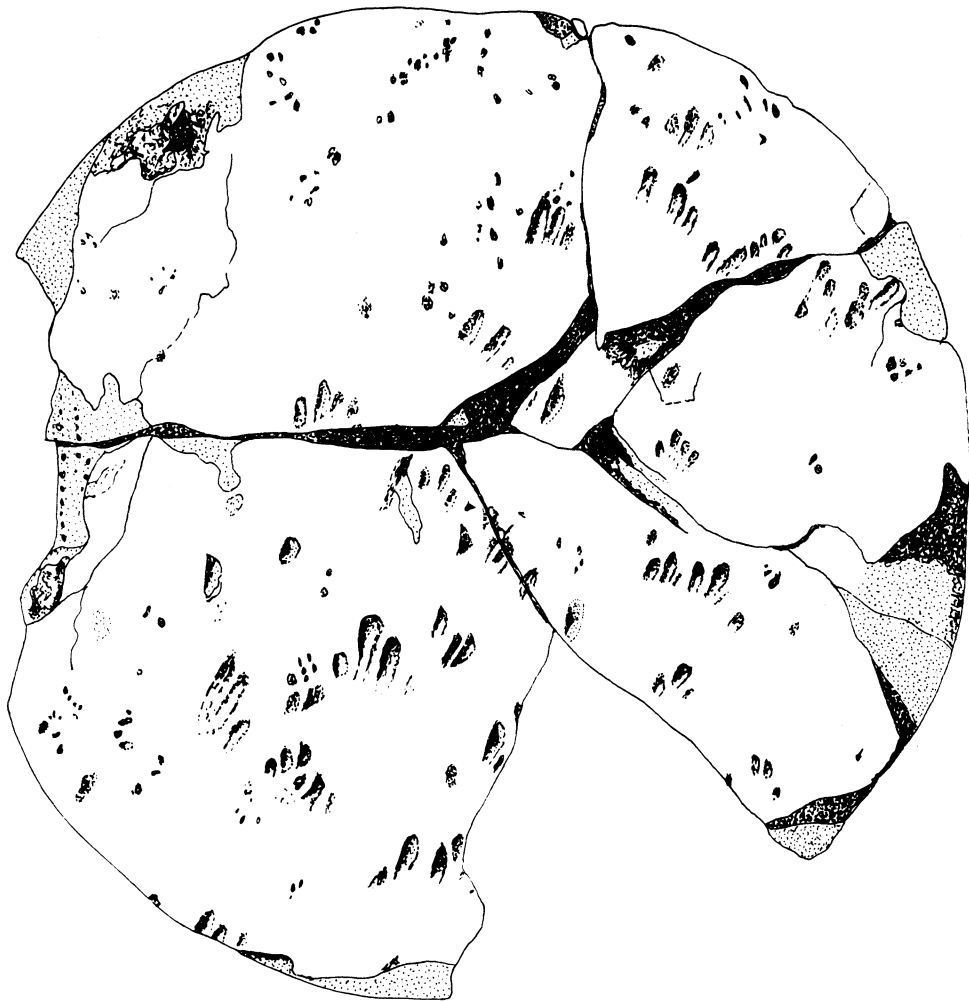
Ichnogenus *Aetosauripus* Weiss, 1934

? *Aetosauripus* sp.

Pl. 31. figs. 1-3. Text-figs, 2b-c, 3f-g.

Description

Trackway is of a quadrupedal, digitigrade reptile of relatively small size, imprinted into wet sand, with consequent loss of detail. Four digits impressed, both in manus and in pes. Manus markedly smaller and narrower than pes, with digit III longest and digit IV rather thumb-like: the digits are closely set and the front part of the palm is impressed. Digits of pes rather spatulate, digit III being again longest: a sole impression is entirely lacking. Claw marks and signs of tail



Text-fig. 1

Borehole core from the Bunter Pebble Beds at c. 1,000 feet depth (BU 2004), showing a trackway (? *Aetosauripus* sp.) impressed into wet sand and a scatter of deeper pits which may be reptilian toe-prints. At extreme left, damage exposes a lower surface with an insect running-track (*Permichnium völckeri* Güthorl). [X 1/3].

drag are entirely lacking. The spacing of manus and pes impressions is not consistent across the slab, but the trackway is not proportionately especially broad in relation to the stride, which is moderately long. These features suggest an animal of light build and high mobility.

Horizon and Locality

Bunter Pebble Beds (Triassic), Bellington No. 4 borehole at c. 1,000 feet depth, Worcestershire.

Dimensions

Length of manus impressions just under 3 cm., breadth under 2 cm. Length of pes impressions over 3 cm., breadth about $4\frac{1}{2}$ cm. (digit 1 is not always impressed). Length of pace about 11 cm., length of stride about 13-15 cm. (NOTE: The condition of the impressions is too inconsistent and the spacing of the footprints too variable to permit accurate measurement). Interdigital Angles (see Text-fig 3f-g). Manus: I-II, 10° ; II-III, 8° ; III-IV, 10.5° . Pes: I-II, 15° ; II-III, 17° ; III-IV 12° .

Remarks

This track does not appear to accord closely with any previously described and thus presents problems of systematic assignation, especially since the condition of the surface into which the tracks were impressed, was too wet to be suitable for preservation of details of digital morphology. Clearly this is the track of a quite highly mobile quadrupedal reptile. The absence of claws and proportionately long third digit militate against a synapsid affinity, whilst the proportionate size of manus and pes suggest a diapsid. The most likely reptiles to which these prints might be attributable, at this particular stratigraphic level, are the pseudosuchians.

No described footprint ichnospecies show any close accord with these prints, *Huenepus keuperinus* Kuhn, 1958 (prints of a digitigrade reptile from the Middle Keuper of Germany) shows the imprint of five digits: it is not clear whether these are quadrupedal prints. *Thecodontipus verrucae* (Tommasi, 1886) von Huene, 1941 (a quadrupedal track of comparable size, from the Keuper of Italy, which shares the character of an elongate third digit) exhibits impressions of five digits on both manus and pes, the fifth thumblike. *Thecodontipus fucinii* von Huene, 1941, also from the Italian Keuper, has an entirely dissimilar manus with stubby, spreading digits. The form of the pes of *Aetosauripus schlauersbachensis* Weiss, 1934, is comparable, though the digits are not spatulate; the manus, however, is clawed (its form is not altogether clear). A tentative assignment to the ichnogenus *Aetosauripus* (to which no other ichnospecies has yet been assigned) is here adopted. These forms are certainly referable to an undescribed taxon, but the medium of preservation renders them unsuitable to serve as types.

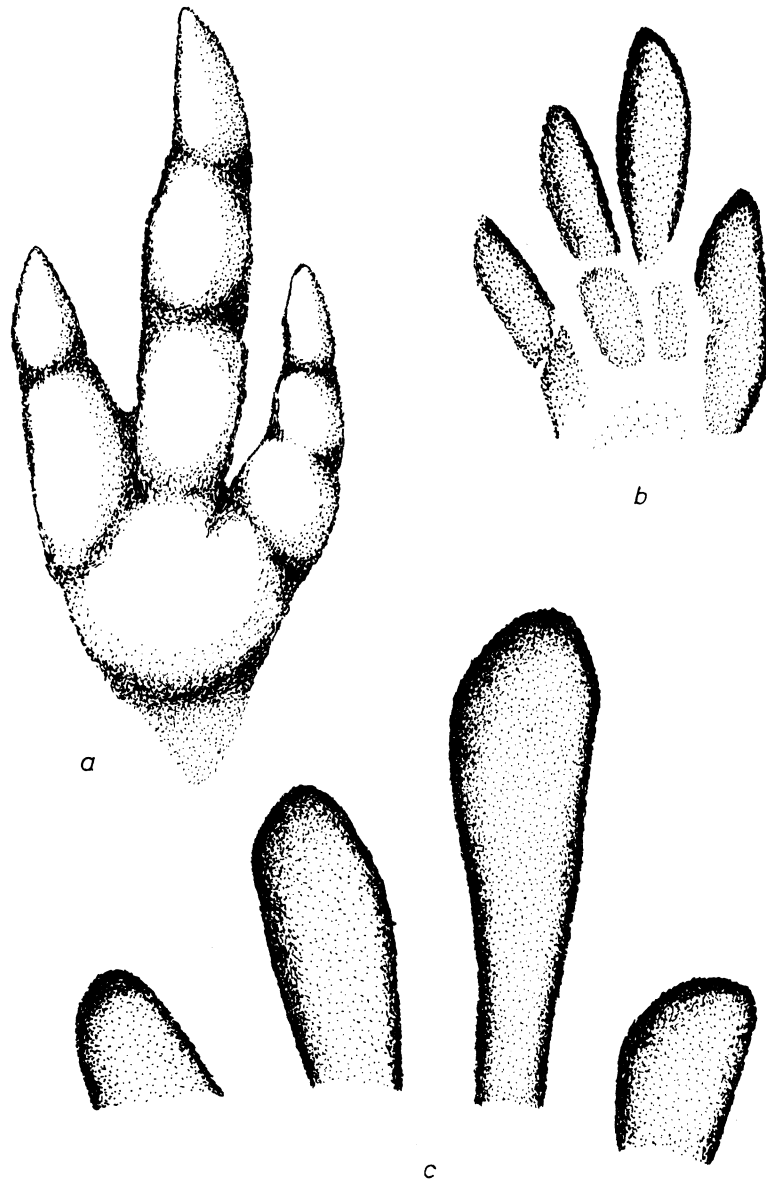
Order Saurischia

Ichnogenus *Coelurosaurichnus* von Huene, 1941,

emend. Sarjeant, 1967

Coelurosaurichnus cf. *ziegelangernensis* Kuhn 1958a

pl. 32, fig. 4, Text Figs. 2a, 3e.



Text-fig.2

a. *Coelurosaurichnus* cf. *ziegelangernensis* Kuhn 1958a: pes (X3)
b - c. ? *Aetosauripus* sp. b. Right manus, c. right pes.
(X c. 2½)

Description

Tridactyl, semidigitigrade prints of a bipedal reptile. The three digits and front section of the heel are most clearly impressed, the back of the heel less clearly indicated. The footprints appear to have been impressed into sand that was almost dry: the impressions are extremely shallow, being clearly visible only under very low-angle illumination, and few details are afforded; the presence of rather blunt claws is clear, but phalangeal pads are scarcely suggested.

The trackway may be determined only with difficulty, since the tracks were not simultaneously visible under the special conditions of illumination needed for their study, but it appears to be narrow, with a short stride. Manus impressions are entirely absent.

Dimensions

Length of pes 5.0 cm., maximum breadth 2.15 cm., length of digit II, 1.25 cm.; digit III, 2.9 cm.; digit IV, c.1.7 cm. Interdigital Angles (Pes; Text-fig 3e.) II-III, 14°; III-IV 8°.

Horizon and Locality

Bunter Pebble Beds, Bellington No. 4 borehole at c.1000 feet depth, Worcestershire.

Remarks

Of the nine ichnospecies so far attributed to this ichnogenus, none shows any close accord with the Worcestershire prints and all are larger in size. *Coelurosaichnus toscanus* von Huene, 1941, from the Keuper of Italy, differs in the relative lengths of digits II (longer) and IV (much shorter). *C. schlauersbachensis* (Weiss, 1934) Heller, 1952, from the Keuper of south Germany, has shorter lateral digits (II and IV), which are outwardly directed. *C. sassendorfensis* Kuhn, 1958a, from the Lower Jurassic of south Germany, has more divergent digits, with digit II proportionately longer. The typical forms of *C. ziegelangernensis* Kuhn, 1958a, from the M. Keuper of South Germany, have broader digits with smaller claws; however, a form tentatively attributed to this ichnospecies by Kuhn (figured 1963, pl. 4, fig.4.) is much more closely comparable, differing only in its broader digits and greater size. Since both these differences might be simply a product of growth, it is considered that the Worcestershire forms should be similarly named.

The trail appears to be that of a small Coelurosaur.

Coelurosaichnus sp. A

Pl. 32, fig. 5. Text-figs. 3d, 4d.

Description

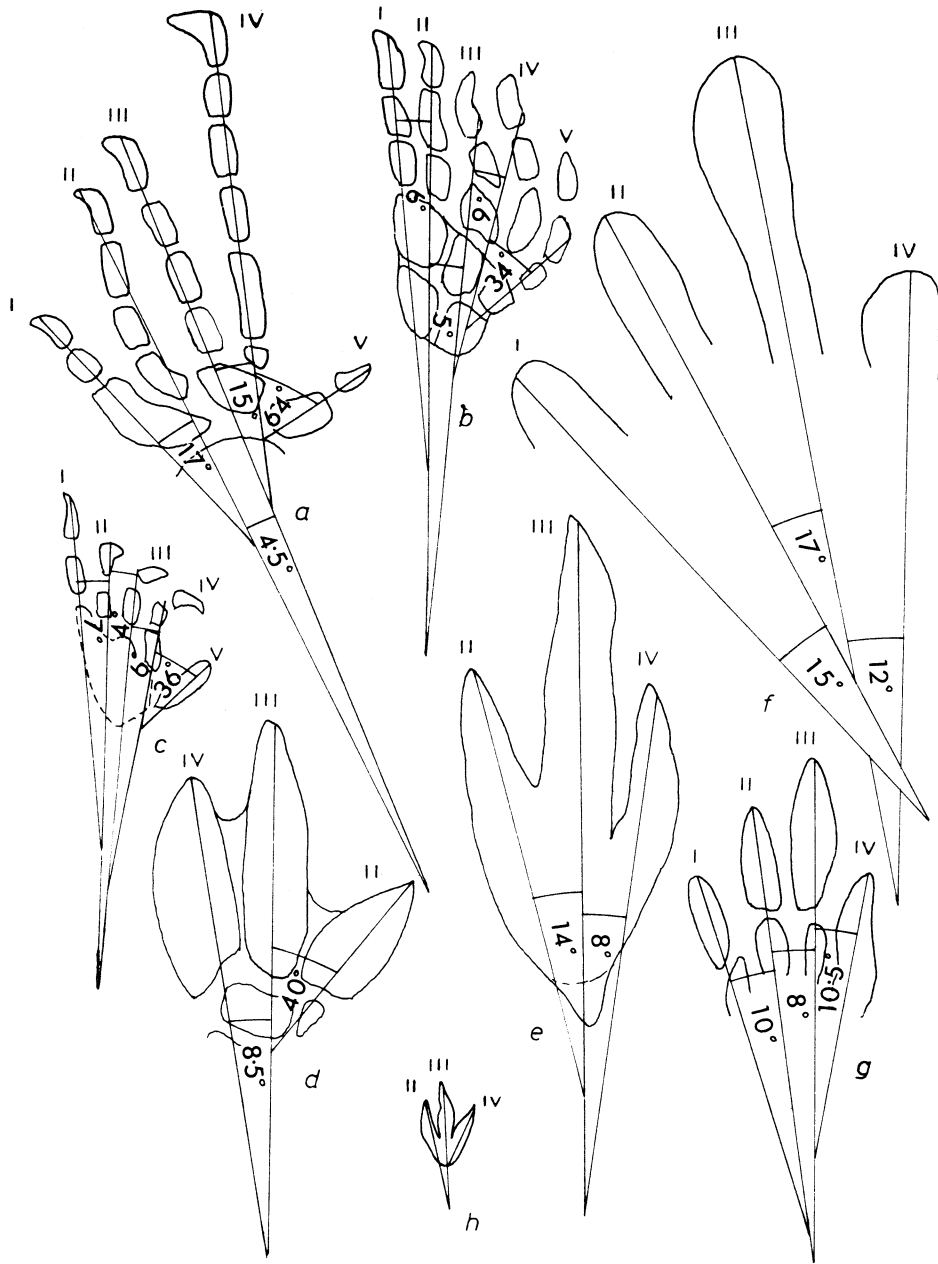
Tridactyl, digitigrade footprint, found as an isolated cast; considered to be probably the right pes of a bipedal reptile. All digits show curvature: claws are not differentiated. The front of the sole is lightly impressed, the digits deeply impressed (see Text-fig 4d).

Horizon and Locality

Bunter Pebble Beds, Bellington no.4 borehole at c. 1,000 feet depth, Worcestershire.

Dimensions

Length of pes. 1.7 cm., max. breadth 1.5 cm. Length of digit II, 0.8 cm; digit III 1.4 cm.; digit V, 1.15 cm. Interdigital Angles (see Text-fig. 3d) II-III, 40°; III-IV, 8.5°.



Text-fig.3

Diagram to show how interdigital angles were taken.
 a. *Rhynchosauroides* cf. *pisanus* b ? *Procolophonipus* sp. c.
 ? *Rhynchosauroides* sp. d. *Coelurosaurichnus* sp. A.
 e. *Coelurosaurichnus* cf. *ziegelangernensis* Kuhn.
 f - g ? *Aetosauripus* sp. h. *Coelurosaurichnus* sp. B.
 (a - d, h X3; e - g, Xc. $1\frac{1}{2}$)

Remarks All named species of *Coelurosaurchnus* are much larger than this Worcestershire print and none exhibits a similar morphology. However, there are three unnamed footprints which merit consideration. In 1850, Harkness recorded (without illustration) a "tridactylous footprint" from the "Bunter Sandstone" of Weston Point, Cheshire: he stated that it had "three well-developed toes" and a length of "about three quarters of an inch" (c. 1.7 cm.). Identity seems probable, but cannot be confirmed without restudy of the lost type. In 1896, Beasley figured and described three-toed prints from the Keuper of Weston Point: the figures are not of high standard, and two of them (pl. II figs H₂ and H₃) might represent the form described here: the types have not been relocated. More markedly similar prints were figured from Germany by Ballerstedt (1922); no name was assigned.

These appear to be footprints of a bipedal reptile, possibly a small (and therefore young) coelurosaur.

Coelurosaurchnus sp. B

Text-figs. 3h, 4c.

Description

Tridactyl, digitigrade footprint, found as an isolated mould; considered to be probably the right pes of a bipedal reptile. Size minute; digits and front part of sole impressed. Claw distinct on digit III, less clear on other digits.

Horizon and Locality.

Bunter Pebble Beds at c. 1,000 feet depth, Bellington no. 4 borehole, Worcestershire.

Dimensions

Length of pes 0.5 cm., breadth 0.3 cm. Length of digit II, 0.2 cm.; digit III, 3.5 cm.; digit IV, 0.3 cm. Interdigital Angles (see Text-fig. 3h) II-III, 10°. III-IV, 30°.

Remarks

This minute print, though it does not accord with any named species, agrees exactly with prints of Beasley's "type M" (1904), which have the same dimensions. Beasley's prints were obtained from the Keuper of Runcorn, Cheshire, and the St. Bees Sandstone (L. Triassic) of Hilton Beck, Westmoreland. In 1963, Kuhn assigned these forms tentatively to *Coelurosaurchnus*; his assignation is adopted here.

Once again, it seems feasible that these are prints of small (young) coelurosaurs, though their dimensions are indeed remarkably meagre!

Order Rhynchocephalia

Ichnogenus *Rhynchosauroides* Beasley in Maidwell, 1911.

Rhynchosauroides cf. *pisanus* (Fucini 1915)

Pl. 32, fig.1. Text-figs 3a, 4a

Description.

Footprints of a digitigrade quadruped. Manus markedly smaller than pes and with at least four digits; exact form not clear. Pes with five digits, slender and clawed. Digits I to IV are of progressively increasing length, digit IV being markedly longest, and bearing recurved claws (see Text-fig 4a). Digit V is opposed and short. All digits show phalangeal pads.

Horizon and Locality.

Bunter Pebble Beds at 886 feet depth. Bellington no.3 borehole, Worcestershire.

Dimensions

Pes: overall length 2.7 cm., breadth (max) c. 1.8 cm., Length of digit I, c 0.9 cm.; digit II, c 1.3 cm.; digit III, 1.4 cm.; digit IV, c. 2 cm.; digit V, 0.5 cm. Manus and trackway not measurable. Interdigital Angles (see Text-fig 3a) I-II, 17° ; II-III, 4.5° ; III-IV, 15° ; IV-V, 64° .

Remarks

These footprints are extremely poorly impressed: even in very favourable lighting, only 2 casts of the left pes proved capable of study. The trackway could not be studied in detail, but appeared to accord in pattern with that illustrated by von Huene (1941, pl. VI fig. 4) for *Rhynchosauroides pisanus*; the slenderness of the digits and the presence of phalangeal pads are other common features, but the recurved claws accord rather with *Rhynchosauroides rectipes* and with Beasley's form D (1904, text-fig.D1), attributed by Maidwell (1911, p. 142) to *Rhynchosauroides articeps* (Owen).

Rhynchosauroides sp.

Text-figs 3c, 4e.

Description

An isolated pentadactyl, digitigrade impression, considered to be of a manus. Digits I-IV of similar length, but showing an increasing measure of curvature: phalangeal pads well marked (see Text-fig.4e). Digit V showing slight opposition, shorter. Faint traces of a palm impression.

An extremely poorly marked tridactyl pes impression is present on the same rock fragment, but its position does not suggest that it is part of the same trackway.

Horizon and Locality

Bunter Pebble Beds at 1005 feet depth, Bellington no.4 borehole, Worcestershire.

Dimensions

Span of digits (maximum) 1.2 cm. Length of digit I 0.65 cm.; digit II, 0.5 cm.; digit III, c. 0.5 cm.; digit IV, c. 0.5 cm.; digit V c. 0.4 cm.; Interdigital Angles. I-II 7° ; II-III, 4° ; III-IV, 6° ; IV-V, 36° . [Note: The curvature of the digits makes these measurements very subjective: see Text-fig. 3c]

Remarks

No named footprint taxon exhibits any close comparability with the form described here: however, it appears identical with the "lacertoid print" described from the Bunter of Germany by Müller, 1934. Although the single print affords insufficient information to permit confidence, the opposition of digit V has determined the attribution of this form to *Rhynchosauroides*.

The presence of the tridactyl track (pl. 2, fig.2) on this same rock fragment leaves open the possibility that this might be the manus of a small coelurosaur. The relative position of the prints, however, does not support the idea that they are part of the same track.

Ichnogenus *Hamatopus* Rühle von Lilienstern, 1939.

Hamatopus sp.

Pl.32. Fig.3. Pl. 3 fig. 5. Text-fig. 4f.

Description

Two isolated casts of a tetradactyl semidigitigrade pes, with digits I-IV of progressively increasing length and digit V lacking. The digits are almost parallel and of moderate thickness, claws are poorly marked, phalangeal pads not distinguishable. The front part of the sole is also impressed. Digit IV is markedly longest.

Horizon and Locality.

Bunter Pebble Beds at 1005 feet depth, Bellington No. 4 Borehole and Upper Mottled Sandstone at 540 feet depth, Bellington No. 3 Borehole, Worcestershire.

Dimensions

Specimen 2022: overall length 2.4 cm., breadth 1.0 cm. length of digit I 0.5 cm.; digit II, 0.7 cm.; digit III, 1 cm.; digit IV, 1.55 cm. Digits almost parallel. Other specimen less completely preserved; not measured.

Remarks

This form differs from the sole species currently placed in *Hamatopus* (*H. wildfeueri* Rühle von Lilienstern, from the German Bunter in that the digits are more closely spaced, the claws not recurved, and the front of the sole is impressed. It exhibits some resemblance to Beasley's type E (1905), from the Keuper of Storeton, Cheshire, in the number and relative length of the digits, but differs in that the claws are much blunter.

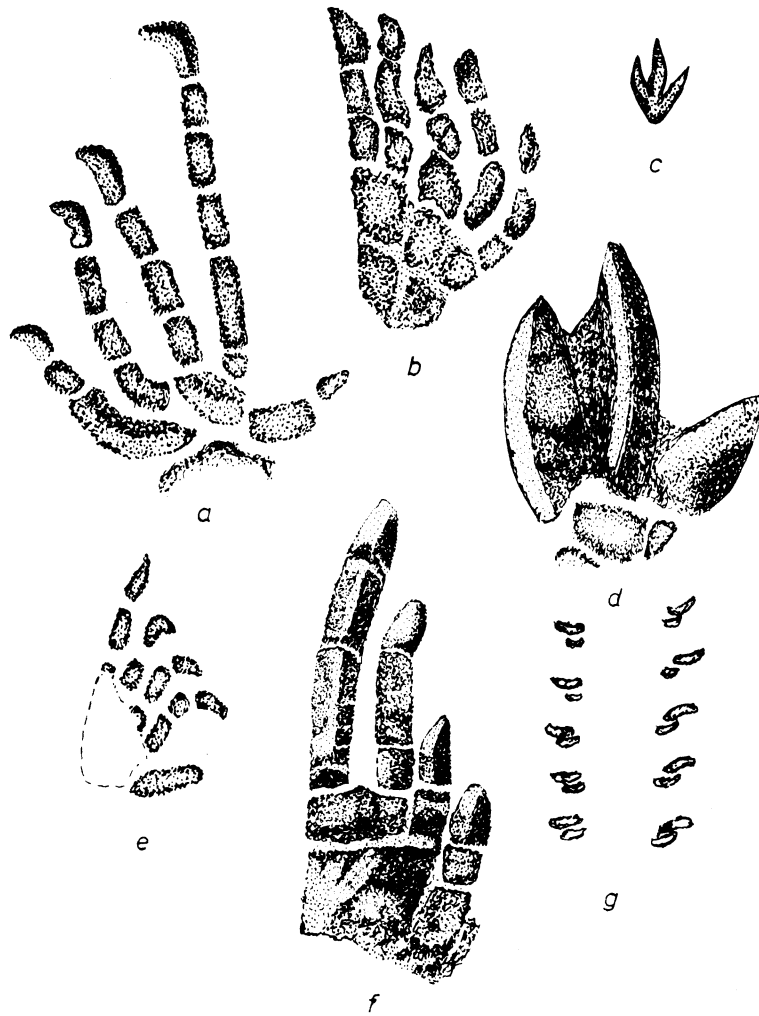
The ichnogenus *Hamatopus* is considered to comprise footprints of either Lacertilia or sphenodontid Rhynchocephalia.

Order Cotylosauria

Ichnogenus *Procolophonipus* Rühle von Lilienstern, 1939

? *Procolophonipus* sp.

Pl. 33, Fig. 4, Text-figs 3b, 4b.



Text-fig. 4

a. *Rhynchosauroides* cf. *pisanus* (Fucini). b. ? *Procolophonipus* sp. c. *Coelurosaurichnus* sp. B. d. *Coelurosaurichnus* sp. A. e. *Rhynchosauroides* sp. f. *Hamatopus* sp. g. *Permichnium völckeri* Güthorl. (a - f X3; g X2).

Description

An isolated, pentadactyl, semidigitigrade impression, considered to be probably of a manus. The digits are each slightly curved and do not differ significantly in length, though digit IV is slightly the longest; their points of junction with the palm occur on a straight line. Phalangeal pads are well marked (see Text-fig 4b). The front part of the palm is quite deeply, the back only lightly impressed. The interdigital angles here quoted suggest some measure of opposition of digit V: but it should be stressed that the curvature of the digits makes these measures extremely subjective.

Horizon and Locality

Bunter Pebble Beds at 733 feet depth, Bellington No. 4, borehole, Worcestershire.

Dimensions

Overall length 1.6 cm.; maximum span of digits 1.55.; length of digit I, 0.75 cm.; digit II 0.7 cm.; digit III, 8.5 cm.; digit IV, c.1.0 cm.; digit V, 0.8 cm. Interdigital Angles I-II, 6°; II-III, 5°; III-IV, 6°; IV-V, 34°.

Remarks

The systematic attribution of this footprint is in highest degree questionable. It is placed with hesitation in the genus *Procolobhonipus* because of the similarity in length of the digits, the fact that they arise from aligned points, and the presence of a sole impression; however, *Procolobhonipus* typically has only four functional digits in both manus and pes. Further information is needed before any confident ichnogenetic assignment can be made.

PHYLUM ARTHROPODA

SUBPHYLUM INSECTA

Ichnogenus *Permichnium* Güthorl, 1934

Permichnium völckeri Güthorl, 1934

Pl. 33, figs. 1-3.

Horizon and Locality

Specimen 2004: Bunter Pebble Beds at c. 1,000 feet depth (trackway on lower surface, exposed by damage, at side of surface of core section with footprints), Bellington no. 4 borehole, Worcs.
Specimen 2029: Bunter Pebble Beds at 886-9 feet depth (slab with 2 ripple-marked surfaces, each with several tracks preserved as casts), Bellington no. 3 borehole, Worcs.

Dimensions

Breadth of trackways between 0.8 and 1.2 cm. Individual imprints c. 0.1 to 0.25 x 0.05 to 0.75 c.m.

Remarks

Trackways of this type were figured by Beasley (1909) from the Keuper of Storeton, Cheshire, and Hardaker (1912) from 'Permian' rocks of Hamstead, near Birmingham. Arthropod trackways of exactly similar morphology occur in the Permian of Germany and were described by Güthorl, in his monumental work on Carboniferous and Permian arthropods, under the name *Permichnium völckeri*. Häntzschel (1962, p. W208) notes that they are running trails of insects, perhaps blattoids.

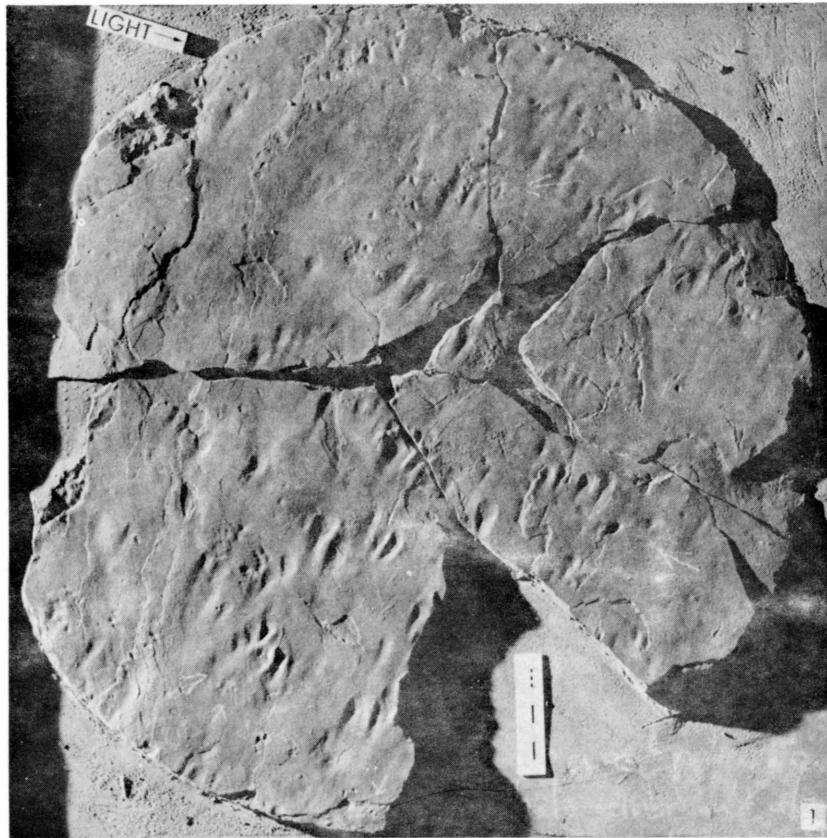


Plate 31

Figure 1 Borehole core from the Bunter Pebble Beds at c. 1,000 feet depth (BU 2004), showing a trackway (? *Aetosauripus* sp.) impressed into wet sand and a scatter of deeper pits which may be reptilian toe-prints. At extreme left, damage exposes a lower surface with an insect running-track (*Permichnium völckeri* Güthorl). [X 1/3,].

Figure 2 *Aetosauripus* sp. Imprint of manus, from same core. [Xc. 1.2/3.].

Figure 3 *Aetosauripus* sp. Imprint of pes, from same core. [Xc. 1.2/3.].

Conclusions

The footprints described here presented especial difficulties of recognition, illustration and description, since they are generally shallowly impressed. The majority are single prints, but, in the cases where trackways are present, their study was not greatly eased - in one instance, because the wet nature of the sediment, when imprinted, has blurred the form of the tracks; in two other instances because, even under the most favourable illumination, only one print was clearly visible at a time. For these reasons, although several of them represent undescribed types, no new taxa are here proposed.

In Britain a considerable suite of footprints has been described from the Keuper Sandstone, which is apparently upper Muschelkalk to Lower Keuper on the German time scale (Warrington, in press; Wills, in press.) Footprints are also on record from the English Keuper Marls (= German Middle Keuper). The suite of forms from the Bellington boreholes is therefore particularly valuable, since the stratigraphical horizons that have yielded the footprints are undoubtedly the Bunter Pebble Beds (f2) and the Upper Mottled Sandstone (f3) of the British succession, which previously has been considered virtually unfossiliferous (see White, 1950). The proved relationship of the two Series to the Keuper Sandstone and to the Permian indicates that the British Bunter, as now defined (Wills 1948 and 1956), correlates with the German Buntsandstein (= Lower Trias.)

Unfortunately all the tracks are much smaller than those found in the German and American Triassic rocks, a fact that precludes close comparison; but the discovery of prints that can be assigned to already described ichnogenera may eventually be of stratigraphical value. It is to be hoped that present work on the collation of data on the German Triassic ichnofauna, being undertaken by Dr. Hartmut Haubold (Martin-Luther-Universität, Halle), will provide a firm framework for correlation by footprints between the Triassic of Great Britain and continental Europe.

In the meanwhile, it has now been proved that the Midlands in Bunter times was far from lifeless, for the vertebrate animals that made the tracks included pseudosuchians, coelurosaurs of three different types., rhynchocephalians of three types and possibly a cotylosaur. The presence of vertebrates implies the presence of other smaller animals - *e.g.* arthropods, worms and '*Planolites*'. Already White (1950) has recorded a Perleid fish from the Upper Mottled Sandstone of Kidderminster (only three miles away from Bellington) and commented on what that implies.

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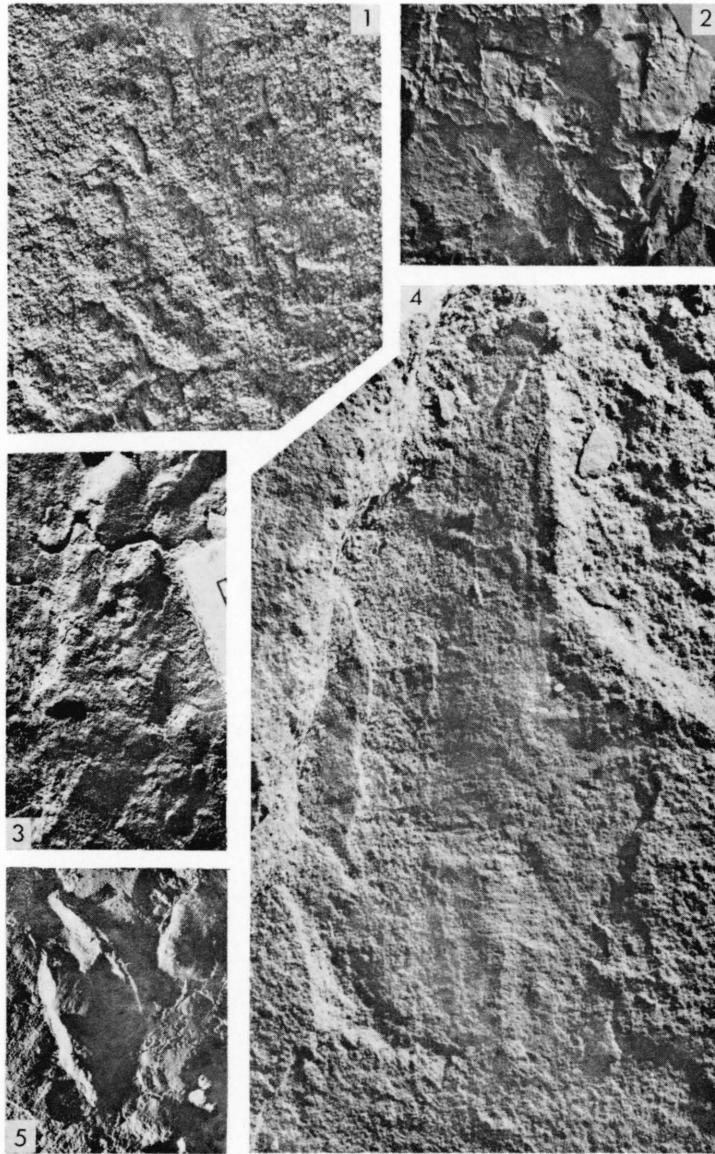


Plate 32

- Figure 1 *Rhynchosauroides* cf. *pisanus* (Fucini) Sarjeant; pes. Bunter Pebble Beds at 886 feet depth. (BU 2029). [Xc.2].
- Figure 2 Tridactyl print; pes? Bunter Pebble Beds at 1005 feet depth. (BU 2019) [X2]
- Figure 3 *Hamatopus* sp: pes. Bunter Pebble Beds at 1005 feet depth (BU 2022) [X3].
- Figure 4 *Coelurosaurichnus* cf. *ziegelangernensis* Kuhn 1958a; pes. Bunter Pebble Beds at c.1,000 feet depth. (BU 2016) [X3]
- Figure 5 *Coelurosaurichnus* sp. A; pes. Bunter Pebble Beds, at c.1,000 feet depth (BU 2023) [X3].

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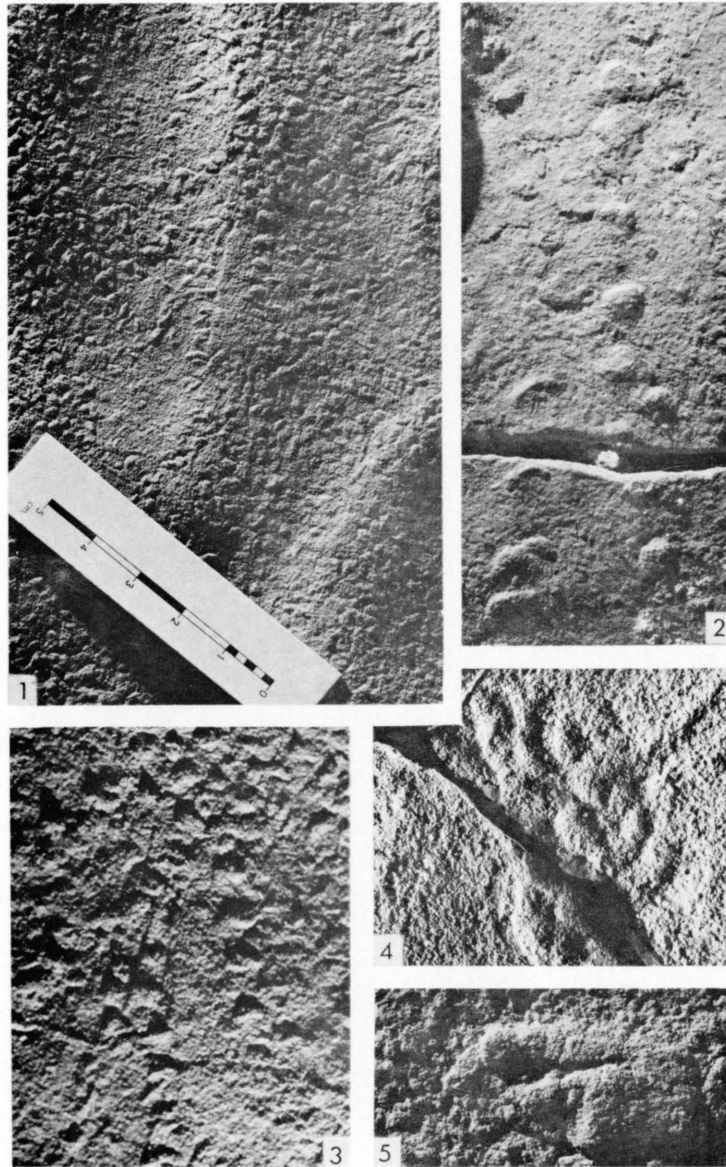


Plate 33

- Figure 1 *Permichnium völckeri* Güthorl, Bunter Pebble Beds at 886-9 feet depth (BU 2029); showing tracks crossing and following the troughs or ripples.
- Figure 2 *Permichnium völckeri* Güthorl Bunter Pebble Beds at c. 1,000 feet depth (BU 2004). [X2].
- Figure 3 *Permichnium völckeri* Güthorl: close-up of track shown in Fig.1. [X2].
- Figure 4 ? *Procolophonipus* sp.: manus? Bunter Pebble Beds at 733 feet depth. (BU 2008) [X3]
- Figure 5 *Hamatopus* sp.; pes. Upper Mottled Sandstone at 540 feet depth. (BU 2028) [X 1.1/2].