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II.—ON *ARCHARENICOLA RHÆTICA*, SP. NOV.

By A. R. HORWOOD (Leicester Museum).

(PLATE XXI.)

GENERAL NOTES ON THE HORIZON OF SPECIMENS A AND B.

IN the latter part of 1910 I was agreeably surprised upon the examination of some material from the Rhætic Black Shales at Glen Parva, Leicestershire, to detect a specimen which at the moment I recognized as new (specimen A).

Reference to this discovery, and to that of a second example in the Museum collections (specimen B), has already been made in brief¹ in the hope that, if other material of the kind existed, I might be apprised of it. So far, however, no further specimens have been obtained.

Specimen A, upon which I found the type, was not found in situ, but the burrows which undoubtedly belong to it are commonly found at 1 to 2 feet above the bone-bed, here the base of the Rhætics, overlying Tea-green Marl.

Specimen B was found by me amongst some old material in this Museum, which I have every reason to believe came from the now covered-up exposure of Rhætic beds at Spinney Hills, reported by the late Mr. W. J. Harrison, F.G.S., a former curator.² This specimen came from the bed numbered 5 in the section given, "sandstone 1 inch." On the other side are broken shells of *Avicula contorta*.

REVIEW OF GROUPING OF FOSSIL POLYCHÆTES.

Amongst Fossil Annelids so far only traces of Marine Polychætes have been detected. These have been subdivided into two groups—(a) *Tubicola* (Sedentaria), in which the parapodia are short and not used for swimming and in which the animal lives in a tube; (b) *Errantia* (Nereidæ), in which the animal is free-swimming and has a well-marked head, well-developed parapodia, with setæ used for locomotion. Some forms included here possessed powerful jaws.

There are really no authentic Palæozoic impressions, since those included in *Nereites*, *Nemertites*, *Myrianites*, *Nemapodia*, *Crossopodia*, *Phyllodocites*, *Naites*, etc., have been regarded as due to movements of Crustacea, Annelids, Gasteropods, and are not impressions of the cuticle at all.³ This being so, the impressions here described must be regarded as belonging to a new order, and they belong to a different group, or Arenicolidæ.

The burrows included the genera *Scolithus*, *Arenicola*, *Histioderma*, *Planolites*, *Diplocraterion*, *Spirocolex*, *Scolecoderma*, some of which were described or grouped by Nicholson.⁴ He considered, as did Nathorst, some of the trails or tracks were perhaps formed by Annelids, Crustaceans, or Molluscs.

¹ Rep. Brit. Assoc. Portsmouth, Trans. Sections, 1911.

² "On the occurrence of Rhætic Beds in Leicestershire": Q.J.G.S., 1876, p. 212.

³ A. G. Nathorst, "On the Tracks of some Invertebrate Animals and their Palæontological Significance": K. Svensk. Vetensk. Akad. Handl., Bd. xviii, xxi, 1881-6.

⁴ H. A. Nicholson, "Contributions to the Study of the Errant Annelids of the Older Palæozoic Rocks": Proc. Roy. Soc., 1873, p. 288.

As to the first group the burrows, such as *Bilobites*, *Rusichnites*, *Arthrichnites*, *Protichnites*, *Climactichnites*, *Scolithus*, have been regarded also by Dawson¹ as due to the movements of various Invertebrates and not as Annelid burrows especially. *Sabellarites* he described as a new sand-tube, and *Buthrotrephis* as a true Fucoid from the Silurian.

The similarity between such impressions and those of the markings made by Molluscs and Crustacea had been pointed out by Professor McKenny Hughes,² so that a great clearance has been made of some of the old lumber that cumbered the ground in the domain of fossil Annelids.

Though this Annelid with its cuticular investment constitutes a new group, I think it unnecessary to make a third for its reception.

NOTES ON SPECIMEN A. (Pl. XXI, Fig. 2.)

Size. Extreme length, 6 cm. Greatest width (upper end), 18 mm.; at centre, 16 mm.

Measurements between annuli. Distance between annuli, 1–2 mm. (5 to a centimetre).

The distance between the annuli varies irregularly; there are some shorter furrows between longer ones, especially in the anterior half, which is the under-side of the raised or relief portion.

In *shape* it is a vermiform impression, slightly curved from below to the left. The impression being flattened, it is difficult to estimate the real diameter or girth of the animal originally. Compressed it forms a thick impression 3 mm.

The posterior portion has a stained outline, 5 mm. thick, on the right side, due to the exudation of animal matter or juices from the soft body preserved in the mud in some combination which is probably bituminous. A portion of the left posterior margin also shows the same character. Wherever the impression is preserved in the Black Shale the same greenish-brown external outline may be seen.

Segmentation. The term annuli has already been given to the transverse ridges that regularly cross the body. Whether it is possible to distinguish the definite arrangement of these annuli into segments, each consisting of so many annuli, cannot be determined owing to the manner of preservation. In *Arenicola*, of which I regard this fossil as a prototype, there are five annuli in each segment, one being larger than the rest and bearing the parapodia. As already noticed there is in specimen A a certain differentiation into two sizes, a large and a small annulus alternating. And to all appearance the appendages, chætigerous parapodia, are attached to the base of the larger annulus. But on this point it is impossible to speak with absolute certainty. In *Arenicola* there are three segments in front of the one bearing parapodia and one behind, and it is possible that the intercalation of three achætous segments is a new feature gained during the evolutionary progress of the genus, or that the apparent arrangement of alternate large and small segments is a variation of it.

Appendages. The body of *Arenicola* may be divided into three regions—an anterior with parapodia, without gills, a middle portion bearing both, and a posterior achætous portion.

The portion of the body to which specimen A may be said to correspond is the anterior non-branchiate portion. Though at first it appeared to be achætous, this portion does undoubtedly exhibit appendages which correspond to the notopodial setæ of *Arenicola*. If the capillary appendages on either side seen at intervals are notopodial setæ, the neuropodia must be invisible and beneath

¹ "On Burrows and Tracks of Invertebrate Animals in Palæozoic Rocks and other Markings": Q.J.G.S., 1890, p. 595.

² "On some Tracks of Terrestrial and Freshwater Animals": Q.J.G.S., 1884, p. 178.

the impression. There is, in fact, no sign of crotchets opposite the straight chætæ. These last are short, barely 5–6 mm. long, and are borne in fascicles so closely associated that they cannot be counted. They are not visible in every part, but are indicated by folds in the matrix, which may be taken to show their position. Within the broken portion of the body-surface in the posterior part are some detached chætæ of a similar nature. As a rule they bear a strong resemblance to the chætæ of *Arenicola marina*. It is not possible to distinguish any spathulate chætæ similar to those in *Arenicola*. As a whole they bear a resemblance to the parapodia of *Nereis*, but are not present on each annulus as in *Nereis*, and the annuli themselves do not show any trilobed divisions as in that genus. The appendages in fact most nearly approach those of *Arenicola*.

Surface. The surface of this fossil for 4.5 cm. of its length is the original cuticle of thick cells which now preserve only the form and arrangement of the external somites and annuli and the epidermal surface characteristics. The upper portion, 1.5 cm., is a cast of the inner surface of the cuticle, and possesses no surface features. As the anterior epidermis of this specimen is wanting, it is impossible to say whether it was like the lower part or not.

In *Arenicola* the anterior and middle part of the cuticle is divided up into well-marked contiguous polygonal areas which give it a wrinkled appearance. In the tail the cuticle is covered with prominent papillæ similar to the anterior arrangements in structure, and doubtless derived from similar definite polygons, originally, becoming rounded or sharply defined with age.

In the specimen A the cuticle is covered with raised papillæ which do not occur on the matrix itself, and are impressions of the papillæ found in *Arenicola* on the tail part. Whether this type had papillæ alone or on the anterior part remains to be investigated. But this worm must have presented in this and other characters already noted a very strong resemblance to the modern lugworm. The anterior third representing the inner surface retains traces in part of the inner tissue, belonging perhaps to the longitudinal muscles, but there is no structure preserved, as everything, except perhaps some chitinous chætæ, is replaced by the black shale matrix.

An exception may be made to the last statement perhaps in the case of the brown layer or ring surrounding the impression itself posteriorly. It is almost certain that this has been produced by a similar substance to the green or yellow pigment which is exuded in recent lugworms by the skin. It is thought by Ashworth to be a lipochrome. Another brown or black pigment insoluble in alcohol is like melanin in this respect, and may be derived from the yellow lipochrome. Indeed, Farroll showed that melanin could be due to chemical change in lipochrome under the influence of an acid. The further homology thus afforded by the probable identity between the brown stain and the pigment exuded by *Arenicola* makes the resemblance irresistible.

Head portion. In endeavouring to uncover part of the impression I found on the left side, in the posterior portion, an impression and counterpart of a terminal part of a similar annelid. This exhibits all the characters of the figured portion, and may be taken to be the head or anterior portion. No details as to the proboscis, peristomium, or other parts can be made out, as it is badly preserved, but there is a cast of what may be regarded as a protruding prostomium with a bifid apex, the lines of the straight stem or base of the prostomium being deeply impressed as two parallel lines, whilst the apex is in bas-relief; and as the other portion in alto-relievo does not show this, it is not possible to be absolutely certain as to the real outline of the structure. It is not exactly like that of *Arenicola*, but bears a considerable resemblance to it. The buccal papillæ of the proboscis, which is not clearly present, are not to be seen, so that it was not protruded. Had this worm been a *Nereis*, which the head portion might have indicated, it would have exhibited palps and tentacles and peristomial cirri, which *Arenicola* does not possess, and as there is no sign of these the homology in this instance again may be taken to be correct. It is fortunate indeed that this terminal portion came to hand, since it settles a point as to which otherwise there might have been difference of opinion.

Burrows. The shales in which this fossil (specimen A) occurs are commonly traversed by burrows which may, and in fact almost certainly must, have been the burrows of this Annelid. They are small in comparison, but have doubtless shrunk and become compressed since they were made. Most are horizontal, and if belonging to a worm of the *Arenicola* type, they belong to the horizontal part of the U-shaped burrow such as it makes in marine sands at the present day. They are irregular and not of great length, though the fragmentary material found can hardly be said to give an adequate idea of their length or true nature. Whether they were U-shaped or not is not clear.

Resemblance to a Myriapod, and difference. There is a superficial homœomorphy between this fossil and some fossil Myriapods. But there is no telson, no spiracles, no spines, the appendages are different (as are the annulation and segmentation). There are no ocelli, and the walking-feet of such fossils as *Acantherpestes* and *Euphoberia* are quite different. *Archarenicola* bears, indeed, on the whole a distinct Annelid character, whilst the fossils called Myriapods are quite distinct.¹

The only resemblance lies in the fact that there is an outline which is regarded as due to the extrusion of the viscera, comparable with the brown zone that we suggest is due to staining by juices exuded by the *Arenicola* type of Polychæte.

Affinities. Having regard to the character of the head portion of specimen A and the parapodia, there can be no hesitation in placing this fossil in the group Phanerocephala, in which the prostomium is distinct, and the segmentation is of the same type.

As regards the sub-order to which it may be referred, there is no doubt that the absence of tentacles, palps, and peristomial cirri, and the simple nature of the parapodia which project, place it in the Scoleciformia, amongst which we find the family Arenicolidæ. The capillary setæ, absence of tentacles, palps, etc., place it in this last family. Whether it should belong to the caudate or ecaudate section is not demonstrable from the material so far to hand, but I should expect from its general characters in other respects that it belongs to the second.

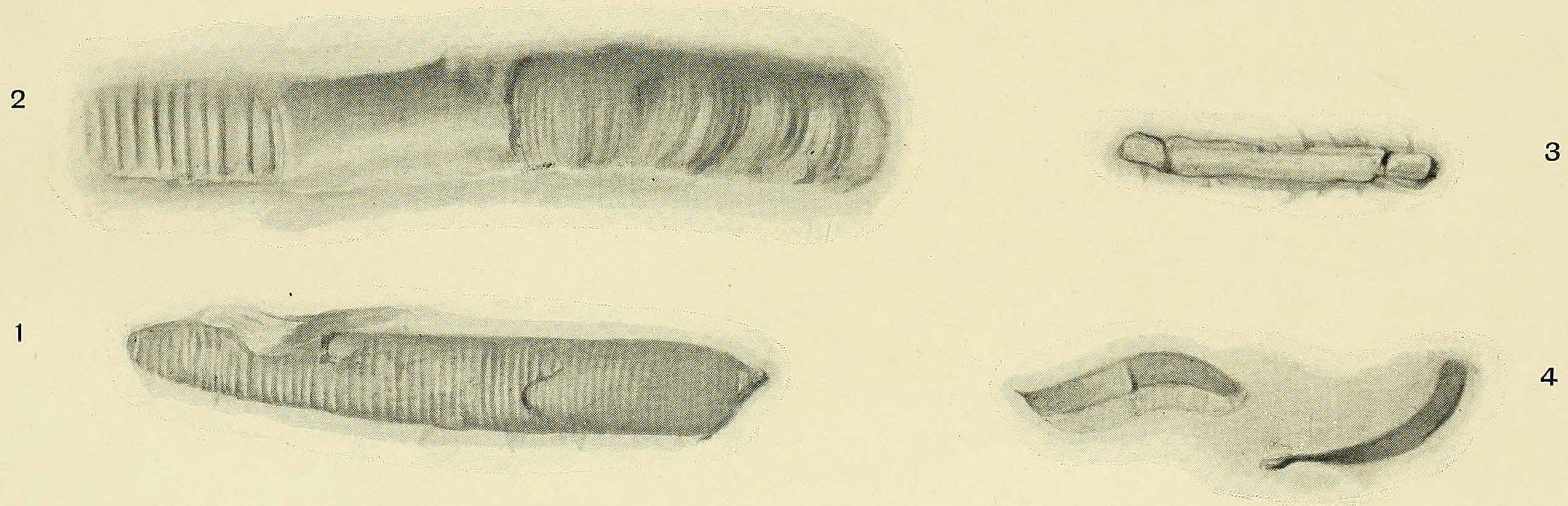
SPECIMEN B. (Pl. XXI, Fig. 1.)

Size. Extreme length, 8.25 cm. ; greatest width, 1 cm.

Measurements between annuli. The distance between the annuli is 2 mm. The annuli themselves measure as much, and the furrows between are deeply marked. This specimen is preserved in an indurated sandstone, and the impression is better marked anteriorly as regards annulation, having a less flattened appearance. At the posterior end the annuli are not so far apart. Anteriorly there are five to a centimetre, and each annulus is equidistant, except in one case, where it is 3 mm. distant from the next. For a great part the impression is covered by the matrix, which it is difficult to remove with advantage. Where it is uncovered elsewhere a black slickenside-like covering obscures the segmentation.

Surface. The anterior portion is an inside cast of the surface, except along the margin, and bears no papillæ. The posterior portion is covered by a black slimy covering, which may originally have been slimy bitumen, containing

¹ "Fossil Myriapods from the Middle Coal-measures of Sparth Bottoms, Rochdale, Lancashire" : GEOL. MAG., 1912, p. 74.



C.M.W.

Archarenicola rhætica, A. R. Horwood, sp. nov. Lower Rhætic : Glen Parva, Leicestershire.

juices exuded by the worm, in this case black. Underneath this, about the centre, are indications of the polygonal areas found anteriorly in *Arenicola*. A few papillæ are present here. Otherwise this specimen is very similar in surface characters to the type, specimen A.

Appendages. There are very few indications of appendages in this specimen, and they are similar in character to those in specimen A, but are only distinct on one side, the left, where they are distant. They are notopodial setæ without a doubt, but though only seen on one side there is no trace of neuropodial crotchets as in specimen A, and they may both therefore be regarded as viewed from the dorsal aspect.

ARCHARENICOLA, NOV. GEN.

An annulated Polychæte, with an impression of the cuticle bearing annuli of two sizes, possibly forming segments. The cuticular surface is covered in the type by epidermal papillæ, in the co-type by polygonal areas between the somites. The appendages are paired, on alternate annuli, consisting of capillary notopodial setæ. The head bears no appendages, but indications of a frilled prostomium. The impression is surrounded by a zone caused by exudations of the juices, as in the present-day *Arenicola*.

ARCHARENICOLA RHÆTICA, SP. NOV. (GENOTYPE).

Characters of the genus, based on specimen A (type) and specimen B (co-type).

Specimen A (Pl. XXI, Fig. 1). Horizon: Lower Rhætic—Black Shales. Locality: Glen Parva, Leicestershire.

Specimen B (Pl. XXI, Fig. 2). Horizon: Lower Rhætic—Black Shales. Locality: ? Spinney Hills, Leicestershire.

Both specimens are deposited in the palæontological collections of Leicester Museum, where they form the third type species of local origin.

I am greatly indebted to the discoverer of the type, Mr. A. J. S. Cannon, for the opportunity of seeing this and other Rhætic fossils of interest, and for much help in other ways. I have to thank Miss G. M. Woodward also for the care which she has taken in preparing the plate.

EXPLANATION OF PLATE XXI.

- FIG. 1. *Archarenicola rhætica*, sp. nov. Specimen A. Lower Rhætic: Glen Parva. Nat. size.
,, 2. *Archarenicola rhætica*, sp. nov. Specimen B. Lower Rhætic: ? Spinney Hill, Leicestershire. Nat. size.
,, 3, 4. Burrows of *Archarenicola rhætica*, in Black Shale, Glen Parva. Nat. size.

III.—NOTES ON LATERITE IN WESTERN AUSTRALIA.

By EDWARD S. SIMPSON, B.E., F.C.S., Geological Survey of Western Australia.

(Communicated by permission of the Government Geologist of Western Australia.)

THE following notes on the laterites of Western Australia are the outcome of a careful study of the series of articles contributed to the GEOLOGICAL MAGAZINE during the latter part of 1911 by Dr. L. Leigh Fermor, entitled "What is Laterite?" These deal with the