This article was downloaded by: [University of Montana]
On: 04 April 2015, At: 11:10
Publisher: Taylor & Francis
Informa Ltd Registered in England and Wales Registered Number:
1072954 Registered office: Mortimer House, 37-41 Mortimer
Street, London W1T 3JH, UK

Annals and Magazine of Natural History: Series 6

Publication details, including instructions
for authors and subscription information:
<http://www.tandfonline.com/loi/tnah12>

XXXVIII.—On the possible origin of the Malpighian tubules in the Arthropoda

Frank E. Beddard M.A. F.Z.S.
Published online: 12 Oct 2009.

To cite this article: Frank E. Beddard M.A. F.Z.S. (1889) XXXVIII.—On the possible origin of the Malpighian tubules in the Arthropoda , Annals and Magazine of Natural History: Series 6, 4:22, 290-292, DOI: [10.1080/00222938909460528](https://doi.org/10.1080/00222938909460528)

To link to this article: <http://dx.doi.org/10.1080/00222938909460528>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs,

expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

gical period from the Upper Silurian strata to the Miocene inclusively.

Whether this non-existence of the Horny Sponges must be left for further investigation to verify or whether it can be explained by deferred development, that is to the present era, or in any other way, I will not go further here than the fact that the Horny Sponges are by far the most abundant at the present day and yet have no fossil representative.

XXXVIII.—*On the possible Origin of the Malpighian Tubules in the Arthropoda.* By FRANK E. BEDDARD, M.A., F.Z.S.

THERE are two sets of structures in the Arthropoda which have been proved to possess a renal function and which have been regarded as possibly equivalent to the nephridia of worms.

The "green glands" of the Crustacea are commonly regarded as nephridia, and researches now in progress will, I believe, establish the nephridial nature of these organs upon a very firm basis of fact.

Among the Arthropoda another class of renal organs exists in the so-called Malpighian cæca. These occur in a few Crustacea, *e. g.* the Amphipoda (Spencer, "The Urinary Organs of the Amphipoda," Quart. Journ. Micr. Sci. xxv. 1885), and in Tracheata; in the latter group they consist of a variable number of glandular cæca which grow out from the proctodæum; in the Amphipoda, on the contrary, Spencer finds reasons for believing that the tubes in question are diverticula of the mesenteron.

The only known Arthropod with unmistakable nephridia, paired and metamerically arranged, is *Peripatus*. The existence of these organs was originally pointed out by Balfour ("On some Points in the Anatomy of *Peripatus capensis*," Quart. Journ. Micr. Sci. xx. 1880), and has been since carefully studied from the developmental as well as from the structural point of view by Sedgwick ("A Monograph of the Development of *Peripatus capensis*," Stud. Morph. Lab. Cambridge, vol. iv. pt. i.). Lankester had previously pointed out that the "coxal glands" of *Limulus* were in all probability to be regarded as modified nephridia, and this position is strongly supported by Sedgwick's results. So far as our present knowledge goes it may be safely assumed that the

"coxal glands" and "green glands" are modified nephridia. Sedgwick remarks (*loc. cit.* p. 119) that with the exception of these structures there are no nephridia in Arthropods recognizable as such; and this conclusion probably represents the opinion of most comparative anatomists. The claim of the Malpighian tubules to be looked upon as nephridia has been more and more ignored. Gegenbaur (*Comp. Anat.*, Engl. transl. by Bell, p. 276) carefully abstains from discussing the morphology of these organs. Lankester ('Notes on Embryology and Classification,' 1877, p. 33) remarks that "in tracheate Arthropods the Malpighian filaments possibly are the nephridia." Balfour (*Comp. Embr.* vol. ii. p. 568) doubtfully compares them to the anal vesicles of the Gephyrea. Now these structures are so widely spread among the Tracheata (even if the tubes of the Amphipoda are not of the same nature) that they must be regarded as among the most characteristic organs of that group. The fact that they do not occur in *Peripatus* might perhaps be regarded as evidence that the Malpighian tubes have arisen within the group; but, on the other hand, their absence from *Peripatus* may be reasonably accounted for by the persistence of unmodified nephridia performing the same function: in any case a similar argument must be applied to account for the great reduction in the nephridia of the Crustacea; they *are* nephridia, and they are reduced in number, in accordance with the reduction of the cœlom.

If, then, the absence of the Malpighian tubules in the most primitive known Arthropod, *Peripatus*, is not necessarily a real break of continuity, the segmented worms are naturally the animals in which one might expect to find the beginning of these organs, especially in the more primitive segmented worms, for the Gephyreans must be regarded as greatly modified Annelids.

In a species of *Acanthodrilus*, which I refer, at present with some little doubt, to *Acanthodrilus multiporus* (Beddard, "On the Specific Characters and Structure of certain New-Zealand Earthworms," *Proc. Zool. Soc.* 1885, p. 813), the last segments of the body are almost entirely filled with nephridial tufts, which, as I have elsewhere stated, open by numerous pores on to the surface of the body and by numerous ciliated funnels into the cœlom. The gut in this region of the body has a very narrow lumen and is lined by tall columnar cells, which are *not* ciliated, as in the intestine generally, but covered with a delicate chitinous cuticle. This region of the gut is probably proctodæum. At irregular intervals *minute caecal diverticula arise from the gut*; these

are at first tubular in character and are lined by an epithelium identical with that of the intestine; as they get further away from their point of opening into the intestine *these tubes* lose their tubular character and *become continuous with undoubted nephridial tubules*, with a duct excavated in the substance of cells; the lumen, at first *intercellular*, becomes afterwards *intracellular*; these tubules were absolutely undistinguishable from the nephridia, and, indeed, appeared to join the general nephridial network of their segment. Their lumen, which was here and there much swollen, contained a granular detritus identical with that occupying the tubes of the general nephridial network. These nephridial appendages of the proctodæum are branched and anastomose one with another; they may certainly be compared to the anal nephridia of the Gephyrea. All that is necessary to convert these structures into Malpighian tubules is to limit their number and arrange them in a regular fashion; the branching and anastomosis even may be retained, as these conditions are met with among the Malpighian tubules of the Tracheata.

If these inferences do not commend themselves to morphologists, I may at least point out that the above facts, of which I give here only a preliminary account, have some bearing upon the origin of the nephridia in Oligochæta. I have put forward an opinion that the original state of the nephridia in this group was a continuous network with numerous irregularly-disposed external pores and coelomic funnels, such as is now largely persistent in certain species of *Perichæta*; and that *Lumbricus*, with its paired metameric nephridia, is the last term in the series which is partially filled up by intermediate conditions. The connexion of the nephridia with the gut is probably secondary, as the orifices were originally external and were carried in by the involution of epiblast to form the proctodæum; *hence the polystomial condition of the nephridia is probably in ontogeny, as in phylogeny, archaic*. An analogous series of facts have been lately brought forward by Spencer, who found ("The Anatomy of *Megascolides australis* &c.," Trans. Roy. Soc. Victoria, vol. i. pt. 1) numerous nephridial openings into the anterior, probably stomodæal, part of the gut. I should refer these facts to the same category as my own, as evidence of the archaic nature of the diffuse condition of the nephridia.