



Annals and Magazine of Natural History

Series 4

ISSN: 0374-5481 (Print) (Online) Journal homepage: <http://www.tandfonline.com/loi/tnah10>

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A.S. Packard Jun.

To cite this article: A.S. Packard Jun. (1875) XXXIII.—On an undescribed organ in Limulus, supposed to be renal in its nature, *Annals and Magazine of Natural History*, 15:88, 255-258, DOI: [10.1080/00222937508681072](https://doi.org/10.1080/00222937508681072)

To link to this article: <http://dx.doi.org/10.1080/00222937508681072>



Published online: 13 Oct 2009.



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first two have intimate relations to each other, and (b) the last three others among themselves; and some weighty arguments may be adduced to support a division of the faunas of the globe into two primary regions coinciding with the two combinations alluded to—(a) a CÆNOGÆA and (b) an EOGÆA, which might represent areas of derivation or gain from more or less distant geological epochs.

In connexion with the geographical distribution of fishes there are a couple of empirical facts which are also specially noteworthy. In the order of Teleostei the Acanthopterygian types are vastly preponderant in the tropical and sub-tropical waters, while the jugular Malacopterygian types (e. g. Lycodidæ, Gadidæ, &c.) form a large proportion thereof in the polar regions. Further, and it is in the same direction, in Acanthopterygian types the vertebræ are actually or approximately 24, divided between 10 abdominal and 14 caudal, in the great majority of the tropical saltwater species; while in the cold-water forms (arctic and antarctic) the number is considerably increased. There are many exceptions to this generalization so far as the tropical forms are concerned; but the tendency in the direction in question is so decided, that while in the warm-water forms of the typical *Scorpeninæ* (*Sebastosomus*, *Scorpena*, &c.) the vertebræ are 24 (A. 10 + C. 14), in the representatives which are peculiar to the high north (*Sebastes norvegicus* and *S. viviparus*) the vertebræ are increased in number to 31 (A. 12 + C. 19). There is, however, no apparent physiological or morphological correlation between these and other facts, and we have in them perhaps nothing more than interesting cases of irrelative coincidence.

XXXIII.—On an undescribed Organ in *Limulus*, supposed to be Renal in its Nature. By A. S. PACKARD, Jun.*

IN dissecting the king crab one's attention is directed to a large and apparently important gland, conspicuous from its bright red colour contrasting with the dark masses of the liver and the yellowish ovary or greenish testes, and presenting the same appearance in either sex. The glands are bilaterally symmetrical, one situated on each side of the stomach and beginning of the intestine, and each entirely

* From an advance sheet of the 'American Naturalist,' communicated by the Author, having been read at the Philadelphia Meeting of the National Academy of Sciences, held in November 1874.

separate from its fellow. One of these glands consists of a stolon-like mass, running along close to the great collective vein, and attached to it by irregular bands of connective tissue, which also holds the gland in place. From this horizontal mass four vertical branches arise, and lie between and next to the partitions at the base of the legs, dividing the sides of the body into compartments. The posterior of these four vertical lobes accompanies the middle hepatic vein from its origin from the great collective vein, and is sent off opposite the insertion of the fifth pair of feet. Halfway between the origin of the vein and the articulation of the foot to the body it turns at a right angle, the ends of the two other lobes passing a little beyond it, and ends in a blind sac, less vertical than the others, slightly ascending at the end, which lies just above the insertion of the second pair of feet. The two middle lobes are directed to the collective vein. Each lobe is flattened out somewhat, and lies close to the posterior wall of the compartment in which it is situated, as if wedged in between the wall and the muscles between it and the anterior portion of the compartment. Each lobe also accompanies the bases of the first four tegumentary nerves. I could not make out any general opening* into the cavity of the body by injection of the gland, or any connexion with the hepatic or great collective vein, all attempts to inject the gland from the veins failing. The four lobes certainly end in blind sacs. The lobes are irregular in form, appearing as if twisted and knotted, and with sheets and bands of connective tissue forming the sheaths of the muscles among which the gland lies. Each lobe, when cut across, is oval, with a yellowish interior and a small central cavity, forming evidently an excretory duct. The gland externally is of a bright brick-red. The glandular mass is quite dense, though yielding. It is singular that this conspicuous gland, though it must have engaged their attention, has not been noticed by Van der Hoeven, Owen, or A. Milne-Edwards in their accounts of dissections of this animal.

When examined under a Hartnack's no. 9 immersion-lens and Zentmayer's B eyepiece, the reddish external cortical portion consists of closely aggregated irregularly rounded nucleated cells of quite unequal size; and scattered about in the interstices between the cells are dark reddish masses which give colour to the gland. They are very irregular in size and

* Leydig ('*Naturgeschichte der Daphniden*') states that several anatomists, after laborious attempts, have failed to find the opening to the green gland in any crustacean.

form, and, twenty hours after the portion of the parenchyma submitted to microscopic examination, vibrated to and fro. I am reminded in the vibrating movements of these bodies of Siebold's description ('Anatomy of the Invertebrates') of similar bodies in the renal organs of the Lamellibranchs, *i. e.* the gland of Bojanus. He says in a footnote, p. 214 (Burnett's translation):—"If the walls of these organs are prepared in any way for microscopic examination, a part of their parenchyma separates into a vesiculo-granular mass, the particles of which have a very lively dancing motion. The motions are due to portions of ciliated epithelium adhering to the cells and granules."

In other portions of the outer reddish part of the gland, where the pigment(?) masses are wanting, the mass is made up of fine granular cells, not nucleated. Other cells have a large nucleus filled with granules and containing nucleoli.

In the yellowish or, as we may for convenience call it, the medullary portion are scattered about very sparingly what are probably the round secreting cells. The nucleus is very large and amber-coloured, with a clear nucleolus; others have no nucleolus; and the small ones are colourless.

I am at a loss to think what this gland, with its active secreting cells filled with a yellowish fluid, can be, unless it is renal in its nature. This view is borne out by the fact of its relation with the hepatic and great collective vein. If future examination shows some outlet into the venous circulation, then its renal nature would seem most probable. No other organ that can be renal in its nature exists in *Limulus*. In its general position and relations it is probably homologous with the green gland of the Decapod Crustacea and its homologue in the lower orders of Crustacea, which is supposed also to be renal in its nature. It may also possibly represent the organ of Bojanus in the Mollusca, which is said to be renal in its function. It perhaps represents the glandular portion of the segmental organs in worms. That so large and important a gland is an embryonic gland, in adult life aborted and disused, is not probable; nor is there any good reason for regarding it as analogous to the suprarenal capsule of the vertebrates, analogues of which are said by Leydig to exist in *Paludina* and *Pontobdella*.

Reasoning from their histological structure and by exclusion, it seems not improbable that these glands are renal in their nature, and homologous with the green glands of the normal Crustacea. They seem also homologous with the organs described by M. A. Giard in the Rhizocephala, and

said by him to be "situated on each side of the middle part of the animal, and generally coloured yellow or red (primitive kidneys?)" (Ann. & Mag. Nat. Hist. Nov. 1874, p. 383).

I may add that all these observations were made on living *Limulus polyphemus*, in the laboratory of the Anderson School of Natural History, at Penikese Island, Mass.

XXXIV.—*On some Fossil Fishes from the Neighbourhood of Edinburgh.* By R. H. TRAQUAIR, M.D., F.G.S., Keeper of the Natural-History Collections in the Edinburgh Museum of Science and Art*.

[Plate XVI.]

I. *Nematoptychius Greenockii*, Agass., sp.

EIGHT years ago I published a paper† giving a detailed description of a fish from the Wardie Shales, which I considered, and still do so, to be the *Pygopterus Greenockii* of Agassiz. Since that time remains of the same fish have turned up in many other localities near Edinburgh, showing that it enjoyed a range extending upwards into the true Coal-measures. Proceeding upwards from the Wardie Shales, it occurs in the horizon of the Burdiehouse Limestone, a specimen in the British Museum (no. 45867) from Burntisland, in Fifeshire, displaying numerous scales and bones of this species, commingled with similar relics of *Eurynotus crenatus*. Numerous specimens also in the Edinburgh Museum of Science and Art, and in private collections, show its not uncommon presence in the "Edge-Coal" strata of Gilmerton and Loanhead, and in the Upper Coal-measures of Shawfair. With the exception of a head, with the anterior part of the body, from Gilmerton, belonging to Mr. Somervail of Edinburgh, and an entire though badly preserved specimen from Woolmet, near Edmonston, in the Museum of Science and Art, all the specimens as yet procured from beds above the Wardie Shales are very fragmentary; yet some of the fragments, from the softer nature of their matrix, afford us some details regarding the

* Communicated by the Author, having been read before the Geological Society of Edinburgh, 4th February, 1875.

† "Description of *Pygopterus Greenockii*, Agass., with Notes on the Structural Relations of the Genera *Pygopterus*, *Amblypterus*, and *Eurynotus*," Trans. Royal Soc. Edinb. vol. xxiv. 1867, pp. 701-713, pl. xlv.