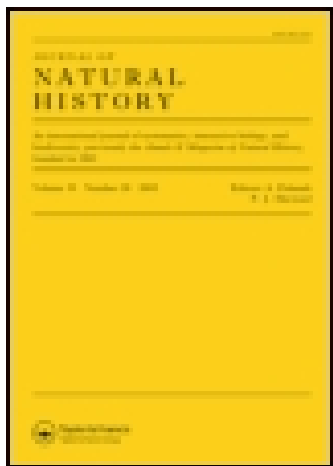


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Annals and Magazine of Natural History: Series 6

Publication details, including instructions
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Published online: 12 Oct 2009.

To cite this article: E.L. Bouvier (1890) XXIV.—On the circulatory system of the carapace in the Decapod Crustacea , Annals and Magazine of Natural History: Series 6, 6:32, 190-193, DOI: [10.1080/00222939008694022](https://doi.org/10.1080/00222939008694022)

To link to this article: <http://dx.doi.org/10.1080/00222939008694022>

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tubes. The amalgamated Malpighian vessels exhibit no dilatation near the opening of the intestine.

The heart or dorsal vessel is constructed exactly as in *S. tipuliformis*.

The respiratory system consists of two large respiratory tubes, placed at the sides of the abdomen, and composed of the united respiratory tubes which run from the tracheæ. These abdominal respiratory tubes are continued to the thorax, and subdivide. At the hinder end of the abdomen the two main respiratory tubes are united in a curve, but there is no connexion between them at any other part of their course, and thus they differ from the respiratory tubes of *S. tipuliformis*, in which the conducting respiratory canals are connected by wide respiratory tubes at each segment.

The male reproductive system is of the same form and construction as in *S. tipuliformis*. It includes:—testes, contained in a common scrotum; two deferent ducts, opening into the large round *vesiculæ seminales*; the *ductus ejaculatorius*, shaped like a long sinuous tube; a horny penis, provided with a furrow; and two long, sinuous, accessory glands.

The female reproductive system consists of the following parts:—(1) two ovaries, (2) two oviducts, (3) vagina, (4) copulatory pouch, (5) *receptaculum seminis*, (6) one unpaired accessory gland, (7) two paired accessory glands, and (8) ovipositor. Each ovary consists of four very long sinuous egg-tubes. These four tubes unite into one common oviduct, and then both oviducts open into the vagina. The *receptaculum seminis* is a little round sac, which opens at one end into the copulatory pouch and at the other into the vagina. The unpaired accessory gland resembles a long, narrow, sinuous tube, provided with two short, rounded, bag-like processes at the upper end. The paired accessory glands resemble two short sinuous tubes. The copulatory pouch is an oval and rather large sac, which opens outwards by a separate outlet through the deferent canal, but which communicates with the *receptaculum seminis* by a connecting tube, and appears to be indirectly connected with the vagina.

XXIV.—On the Circulatory System of the Carapace in the Decapod Crustacea. By E. L. BOUVIER*.

THE circulatory system of the Decapod Crustacea, as described in the classic memoirs, after the investigations of Lund,

* Translated from the 'Comptes Rendus des Séances de l'Académie des Sciences,' tome cx., June 9, 1890, p. 1211 *et seq.*

Krohn, and, above all, of H. Milne-Edwards, consists (1) of an arterial system which conveys the blood directly from the heart and pours it into the lacunæ of the body-cavity, (2) of a branchial system in which the blood from the lacunæ, after being arterialized, circulates in the direction of the heart, and is eventually poured into the pericardial chamber by which the latter is surrounded.

Huxley reproduces these ideas in his work on the Crayfish, and adds that the pericardial sinus is perhaps partially occupied "by some blood which has not passed through the branchiæ, though this is doubtful" *. Claus, in a recent paper, is much more positive; he states that the membrane of the carapace always contains venous blood, derived it may be from the lacunæ of the body-cavity, it may be from the arterial extremities of the tegumentary branches of the lateral anterior arteries (antennary arteries), and he justly observes that this blood "certainly does not flow into the branchial sinus for the purpose of passing through the branchiæ, but passes directly from the body-walls into the pericardial sinus" †. The learned carcinologist appears to make use of this fact to combat the opinion of Milne-Edwards, who holds the heart of the Decapod Crustacea to be an arterial heart in the sense that the Molluscan heart is; however, he merely formulates, without further details, the rule quoted above, contenting himself with describing very minutely the circulation in the carapace of the *Phyllosoma*-stage of the larva of the lobster.

Now, if we consider that the larvæ of Decapod Crustacea, before the branchiæ appear, have no other respiratory apparatus than the membrane of the carapace, and must therefore respire in the same manner as *Mysis* ‡, we are forced to believe that, in the absence of demonstrative proof, we cannot draw conclusions from the larva as to the adult, and we ask ourselves whether Milne-Edwards may not be right after all in holding the Decapod heart to be exclusively arterial.

Numerous experiments and a large number of injections performed on crayfish (*Astacus fluviatilis*), on species of *Pagurus* (*Eupagurus Bernhardus*, *E. Prideauxii*), on *Dromia* (*Dromia vulgaris*), on aquatic crabs (*Platycarcinus pagurus*,

* Huxley, 'The Crayfish; an Introduction to the Study of Zoology,' p. 56 (1880).

† Claus, "Zur Kenntniss der Kreislaufsorgane der Schizopoden und Decapoden," Arbeiten aus dem Zool. Instit. d. Univ. Wien, Bd. v. p. 40 (1884).

‡ Delage, "Circulation et respiration chez les Crustacés Schizopodes (*Mysis*)," Arch. Zool. Exp. 2^e série, t. i. (1883).

Carcinus mænas), and on land-crabs of the genus *Cardisoma*, have enabled me to study in all its details the circulation in the membranous walls which clothe the carapace in the branchial region, and to substantiate by definite investigations on adults the rule enunciated by Claus.

The afferent system of the membrane which clothes the carapace in the branchial regions has its origin in the vast postcephalic lacuna which surrounds the liver and the entire stomach; a quantity of blood, very variable in amount in the different types, also enters this membrane by the ultimate branches of the lateral anterior (antennary) and posterior arteries. In the land-crabs of the genus *Cardisoma*, as in *Birgus latro*, which was studied by Semper, the largest portion of the blood is drawn from the ventral region of this lacuna and forms a large trunk in front, which then divides into several branches, the secondary divisions of which are very numerous, very minute, and gather themselves into a plexus; but in the more distinctly aquatic Decapod Crustacea the large afferent trunk usually does not exist, and we are confronted with an infinite number of little anastomosing lacunar canals, which detach themselves from the lacuna at its points of contact with the membrane.

The efferent system is absolutely constant; it consists of a well-defined trunk which follows the membrane close to the lower free border of the carapace; very narrow anteriorly, this trunk receives on its way the efferent branches of a plexus which is continuous with the afferent plexus; it increases considerably in size the further back it gets, and opens directly into the pericardium either at its posterior angle (*Astacus*) or at the sides (edible crab, *Cardisoma*). The whole of the efferent system, the pericardium, and the entire arterial system can be easily injected by way of this large efferent trunk.

In studying the disposition of the afferent and efferent canals in this region of the membrane we are soon convinced that we are dealing with a cutaneous respiratory apparatus analogous to that of *Mysis*, and that it is the exaggeration of this arrangement which allows certain Crustaceans (land-crabs, *Birgus latro*) to live a very long time out of the water. In other words, the blood which returns directly to the pericardium by way of the large efferent trunk of the carapace is not venous but arterial blood. It is possible that a portion of the venous blood of the lacunæ returns directly to the pericardium, and we even find two orifices at the bottom of the pericardial sinus of the edible crab, which seem to be intended to serve this purpose; but in any case we are bound to concede to the system of the carapace an efficient respiratory rôle.

We may sum up our results as follows:—In the Schizopods and in the abbranchiate larvæ of Decapod Crustacea respiration is purely cutaneous and is principally effected in the membrane which clothes the lateral walls of the carapace. In the adult Decapods this respiratory apparatus persists, and presents an absolute fixity, at any rate as far as regards its large efferent canal; but a secondary respiratory system is added to that of the larva, and it is this latter system, in which the branchiæ are intercalated, which is really the only one described in the classic works. This branchial system is undoubtedly the more important from a physiological point of view (except perhaps in the terrestrial species); but it is a secondary apparatus which in no way lessens the importance of the cutaneous system.

XXV.—Description of a new Species of Mormyrus.

By G. A. BOULENGER.

Mormyrus mento.

D. 29. A. 36. V. 6. L. lat. 85. L. tr. $\frac{13}{8}$.

Snout short, curved, once and a half the diameter of the eye, $\frac{1}{10}$ the length of the head. Mouth terminal, on a line with the lower border of the eye, its width one fifth the length of the head. Teeth moderately large, notched, five in the upper jaw, six in the lower. Diameter of the eye one fifth its length, about two thirds the width of the inter-orbital space. Chin strongly swollen. Origin of the dorsal halfway between the gill-opening and the caudal, and above the ninth ray of the anal. Pectoral as long as its distance from the nostrils, extending a little beyond the base of the ventral, which measures nearly half the length of the head. Depth of body $3\frac{1}{2}$ times in total length (without caudal), length of caudal peduncle $5\frac{1}{2}$ times; depth of caudal peduncle one fourth its length. 12 scales round the caudal peduncle. Silvery, with fine brown dots, which are very crowded on the head and the dorsal and ventral lines.

Total length 190 millim.

Closely allied to *M. senegalensis*, Stdr., from which it is distinguished by the smaller scales and the more slender caudal peduncle, and to *M. cyprinoides*, L., which has smaller teeth and a deeper caudal peduncle surrounded by 16 scales.

A single specimen, from the Gaboon.