

NEOMENIA

A NEW GENUS OF INVERTEBRATE ANIMALS

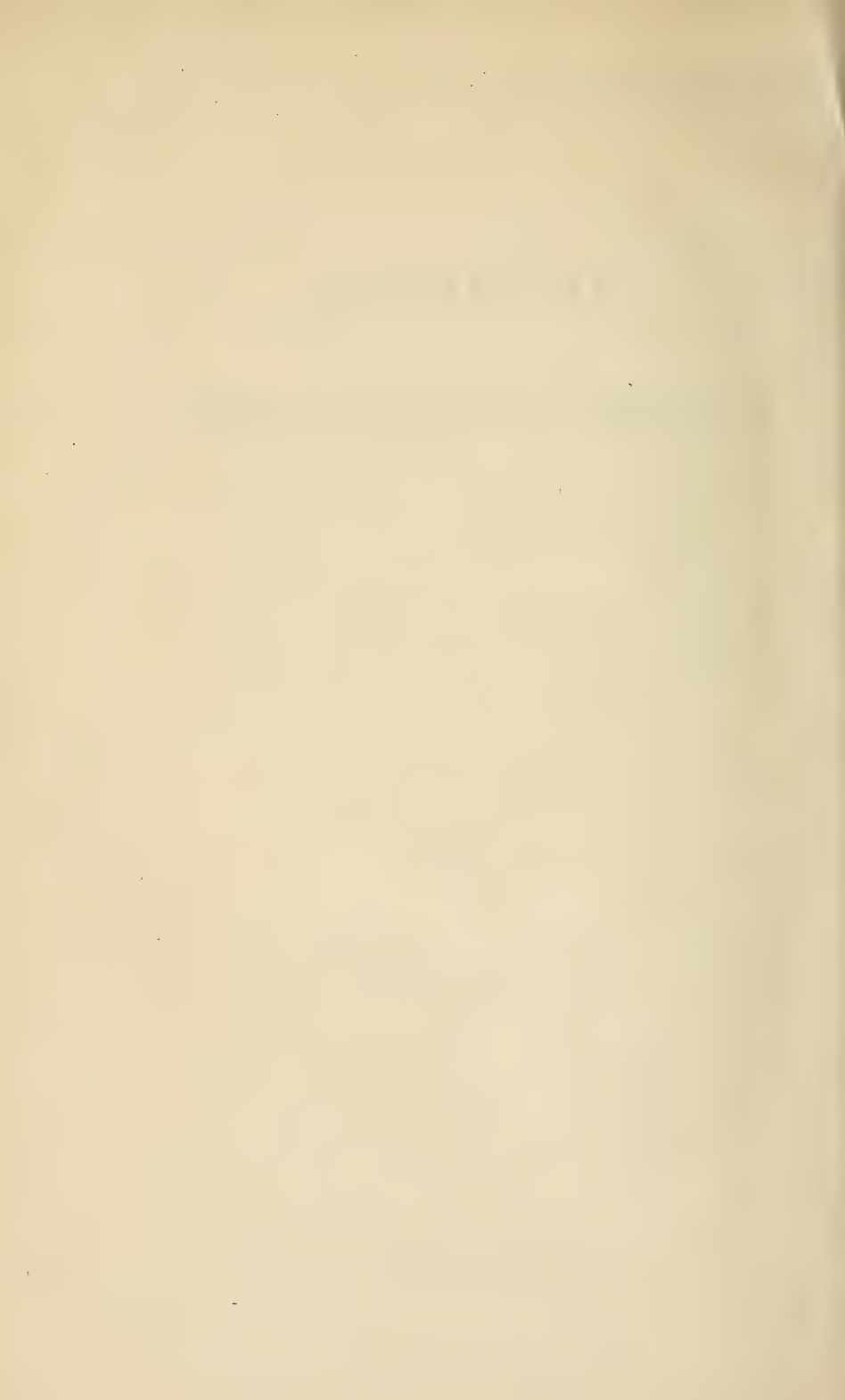
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WITH TWO PLATES.

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When residing last summer among the islands and fiords of the western coast of Sweden, I met with an animal, the mere external appearance of which immediately attracted my particular attention. It was dredged at a depth of about 50 fathoms. Unfortunately I obtained only one specimen, and as I was but slenderly provided with zoological books, I thought it best to defer the anatomical and histological investigation of it, till I could command a more extensive literature. I thus lost the opportunity of studying the tissues while still fresh, and from this many deficiencies in the following description arise. That I have, nevertheless, obtained some results, I owe to the kindness of Professor S. Lovén, who obligingly placed at my disposal five specimens of the same animal preserved in the National Museum of Zoology in Stockholm. They were all from the fiords of our western coast, and mostly captured by Professor Lovén himself. Of the six specimens I thus have had at my disposal, four have been used for anatomical researches.

*Neomenia*¹⁾ *carinata* n. wants every trace of articulation. When in a contracted state (1, 2, 3.) it is curved almost in the form of a halfmoon, somewhat compressed above, so that a longitudinal ridge is formed along the back. Only one of the specimens of which I could avail myself was extended (4, 5.). The under profile was almost straight, whereas the back remained somewhat convex. The specimen I have myself taken continued to live a couple of days in seawater, during the whole of which time it lay, in a contracted state, on its side, showing no other signs of life than an occasional opening of the anal aperture. The colour of the animal was

¹⁾ *Νεομηνία*, alluding partly to the lunated form of the body, and partly to the novelty of its structure,

light grey with a shade of rosy red around the anus. The largest specimen that I opened was, in the contracted state, 20 mm. long, the smallest but little more than 8 mm.

The external covering is very thick and firm, and densely set with very minute spines, scarcely visible to the naked eye, but giving it a velvety appearance. The most remarkable feature in the animal is its alimentary canal, forming an extensive internal hollow, or stomach, (6 d), and not surrounded throughout the greater part of its length, by any perivisceral cavity. Behind it tapers to a short rectum (6 f) terminating in a tolerably wide anal orifice (6 g). The mouth, which is situated in the fore-part of the body, consists of a protrusible pharynx (6 b). In the specimen found by me this organ was entirely drawn in, in one of the others it seemed to be fully extended (10 b). Immediately above the stomach lies a single ovary (6 u) extending backward to the commencement of the rectum, where it is bounded by a sackshaped organ (6 x). In a cavity connected with the anterior wall of the rectum lies a peculiar and probably protrusible organ, in form something like an inverted mushroom (6 q). In the midst of this organ opens the common efferent duct of two large glands situated one on each side of the rectum. The under part of the rectum is free, unconnected with the surrounding organs, and thus a sort of perivisceral cavity may be here discerned (6 o). With this cavity communicates a tolerably broad canal (6 n), beginning immediately behind the pharynx and extending backward in the mesial line of the lower part of the covering. At the anterior extremity of this canal are placed two infra-esophageal ganglia, each sending out backwards a strong nervetrunk (7 β) running parallel with the canal just mentioned. In front they are connected with a single supra-esophageal ganglion (6 p). There are moreover two other longitudinal nervetrunks, proceeding one along each side (7 γ).

After this short account of the animals appearance and the relative position of the different organs, I proceed to a detailed description of the form and structure of these parts, as far as they have been made out at present.

The integument consists of a thin cuticle, with a matrix also thin, and under these two coverings, a very thick muscular coat. The outermost surface is studded with wartlike

elevations (23), and it is between these warts that the above mentioned spines are situated. Some of these are smaller (0,1 mm. long, 0,004 mm. broad) and appear merely as rounded bristles, slightly bent, without any cavity (21, 23), others are considerably larger, nearly straight (0,1 mm. long, 0,01 mm. broad) with a longitudinal groove (20), out of which those situated along the ridge of the back are suddenly dilated near the free end (17, 18, 19). The substance of these spines appears to be carbonate of lime, as it dissolves rapidly, developing gas, on the application of acid. The grooved spines are filled with a granular substance. The muscular coat, which in the larger specimens attains a thickness of about 1 mm., is remarkable for its abundance of connective tissue. This consists of a homogeneous substance (22 a), in which are found scattered cells, some smaller (0,008 mm.), provided with ramifications (22 b, 24, 25), some considerably larger (0,025 mm.), oblong and without any ramifications (22 c, 26). These last-mentioned cells contain a granular yellowish matter, and are provided with a strongly refracting nuclear body. Besides these two kinds of cells, I have in two sections observed other rounded cells, somewhat smaller than the last-named, but with conspicuous nuclei and colourless contents (27).

In this connective tissue muscle- and nerve-fibres are imbedded, and a great number of ramified canals. The muscular fibres (22 d) are linear and more or less flattened. I have not been able to see any distinct nuclei in them. Viewed edgewise, they present a narrow strongly refracting stripe, whereas viewed sidewise, they appear longitudinally striped. In the inner part of the muscular coat the muscles are much more numerous than in the outer part, and lie close to each other, forming actual strata or bands. Innermost is a layer of ring-muscles of but trifling thickness, after which come longitudinal threads, which are most numerous in the under parts of the body, where they form broad contiguous bands (7 a). These bands decrease in strength upwards, till on the upper parts of the body they almost disappear. Outside them comes another pretty thick layer of ring-muscles, from which issue a number of threads obliquely outwards, towards the surface of the body. Outside this external layer of ring-muscles, the threads become less numerous, while the connective tissue increases in quantity. Most of these threads run in a longitu-

dinal direction. A large number of radial, generally finer, muscular fibres passes across through all these layers (22 f').

A number of fine branching canals also extend through the connective tissue (22 i). They are filled with rounded cells (28), and can hardly be anything else than blood canals. Whence these have their origin, I cannot with certainty say, but they probably communicate with the larger canal (6 n), that runs along the under wall of the muscular coat, and therefore also with the cavity surrounding the inferior part of the rectum (6 o). Under, and parallel to that canal, the integument forms a rather deep furrow (6 k), beginning immediately behind the mouth, with a vertically directed passage, which dilates somewhat inwards, but seems to terminate blindly (6 l). Backward the furrow is continued to the anus, and its bottom exhibits a number of longitudinal folds, of which the middle one is the largest (6 m). When the animal is contracted, the furrow is scarcely visible from without (2 c), but becomes gradually distinct as it extends itself (4 c).

The nerves in the muscular coat (22 g) are at first sight like the muscular fibres, but are easily distinguished from them by their ramifications. They in fact send out a number of larger or smaller branches, which penetrate the connective tissue, and sometimes interlace with each other so as to form a net-work. With the nerves a number of cells containing pigment (15, 16, 22 h), are connected. They are often provided with several ramifications, and sometimes form a sort of dilatation of the nerve itself. The upper esophageal ganglion (11) is of an elliptic form, and from it proceed a large number of nerves, at least six on each side. I have not been able to follow these very far, and cannot therefore describe their course, but it is evident that a pair of them are united with the inferior ganglia (12). These are of an oblong triangular form and are united by a very slender commissure. From these ganglia, behind, proceed the two abdominal nerves, sending out branches on both sides (13, 14). Whether any of these branches pass over from the one nerve-trunk to the other, I cannot with certainty say, though I think I could sometimes discern such to be the case. The two ventral nerves go, as has been stated above, one on each side of the canal that passes through the inferior wall of the body, and between them and this canal is a peculiar tissue consisting of rounded

cells, each containing one strongly refracting granule. Not only the ventral nerve-trunks, but also the two lateral nerves (7 γ) appear to lie in a sort of canal, which was particularly distinct round the side-nerves in the extended specimen. These canals, which are much smaller than the great ventral canal (6 n, 7 n), are probably also a sort of bloodvessels. The two lateral nerves undoubtedly originate in the supra-esophageal ganglion. The ganglia are covered with a membrane consisting of connective tissue, within which is a mass of irregular cells, with ramifications. No ganglionic enlargements appear on the great longitudinal nerve-trunks.

The alimentary canal is composed of three principal parts: the pharynx, the stomach, and the rectum. The pharynx again consists of two parts, of which the posterior (6 c) forms an annular fold, which contracts (9 c, 10 c) when the anterior part is protruded, and when that is contracted, dilates and surrounds it like a crown (6 c, 8 c). The anterior part (6 b, 9 b) dilates when protruded, and thus covers the surrounding portion of the skin (10 b). The stomach commences immediately behind the pharynx. It is peculiarly broad, occupying more than two-thirds of the body's breadth, and more than half its length. From the side-walls of this large cavity project a great number of closely set transverse lamellæ (6 e, 7 c), giving it a most peculiar appearance. The substance of these lamellæ is composed of a membrane of connective tissue which for the greater part of its length is fastened to the wall of the muscular coat and, like it, traversed by muscular threads. The upper extremity of the lamellæ is united with the membrane that divides the stomach from the ovary (7 v). The whole stomach, together with its lamellæ, is covered with a thin layer of a brownish soft tissue, in which I could not discover any distinct cells. The rectum (6 f) is rather narrow in the middle, but considerably dilated just before the anus. This more spacious portion is provided with a number of lamellæ, of considerably smaller dimensions, however, than those in the stomach, and placed in a longitudinal direction (6 h).

The ovary (6 u) is bounded on its under side by the walls of the stomach, and on its upper side by the muscular coat. The whole organ is divided by transversal membranes (6 w) of connective tissue into a number of compartments

for the most part wider outwards than inwards. These compartments are filled with laminae, which, in the largest specimen that I examined, were, with the exception of the hindmost, composed of eggs in different stages of development, so arranged that the most developed were placed outermost (32). The innermost part of every lamina is formed of small cells probably of the same character as those from which the eggs had been developed (33). Such cells were also found between the eggs. In two smaller specimens on the contrary the exterior portions of these laminae consisted of a granular substance, also cellular, but of an entirely different character from the cells just mentioned (34). In these specimens only the inner parts are occupied by eggs and egg-cells (35), but in them also the arrangement is such that the largest eggs are outermost. I have not been able to discover either in what relation the granular mass stands to the eggs, or by what means the eggs, when mature, are discharged from the ovary. It would be natural to suppose that they come out into the stomach by breaking through the walls of the ovary, and are afterwards discharged through the anus, but this would be inconsistent with their appearing in the bag (6 x) behind the rectum. This bag I found, at least in the larger specimens, filled with a number of irregular bodies exactly resembling the more mature eggs in the ovaries, but with their contents less transparent and without any distinct nucleus. I cannot conjecture what else these can be than eggs, though I cannot account for their presence in the bag. In this organ are also three singular bodies, one above and two below, which in the smaller specimens looked like mere elevations on the wall of the muscular coat, but in the largest specimen differ considerably; inasmuch as that, throughout the greater part of their length, they are free, and the upper one is longitudinally divided by a furrow (6 y). The compartments of the ovary nearest to this bag contain no eggs, but are filled with laminae of a yellow shining substance, the nature of which I am not at present able to explain. No external limit is visible between this part and the rest of the ovary, and the yellow shining laminae begin almost immediately where the formation of the eggs ceases. Possibly this organ may communicate with the two large lateral glands (29 a). These two glands, of which I did not succeed in making entirely uninjured pre-

parations, and to the structure of which I have not paid particular attention, I shall here only mention in a few words. They show a somewhat large lumen in which the inner membrane forms very deep folds. The mushroom-shaped organ (29 b) which contains their common efferent duct is, at its free and dilated end (30), provided with a number of conical excrescences (31), and the widening of the rectum, in which this organ is inclosed, has a great number of leaflike protuberances (6 t). It seems to me probable, that the two glands are testes and that the mushroom-like organ performs the office of a penis, but to make this matter clear, living specimens are of course necessary. In front of each of these glands is a cordlike organ of a very peculiar kind (36). This organ is fastened by its anterior and upper extremity (36 a), to the muscular coat beside the back part of the ovary. From this point it extends backwards and downwards to a point immediately in front of the anal orifice, where the lower extremity (36 b) seems to be attached to the muscular coat. But before reaching this point it gives off two pretty strong branches, the anterior of which (36 c) is attached to the muscular coat and the posterior or inner (36 d) to the wall that incloses the hollow, in which the organ supposed to be a penis, is situated. The cord-like organs each contain two staff-like bodies, probably of carbonate of lime. Both these staves are thicker at the upper end, and gradually taper downwards; but whereas the one is awl-shaped and almost round (37 a), the other is shaped into a furrow in which the first is placed (37 b). The cordlike covering, which incloses these two staves, appears to be differently constructed in different parts, but is generally distinguished by its fibrillous character. Part of the fibres are connected with small cells, and present a most singular appearance, somewhat resembling the ganglionic cells in the sympathetic nerve-system of the higher animals. It seems in fact as if there proceeded, in opposite directions, a thick thread from each side of the cell, spun round with other fine threads issuing from the same cell. On closer examination I think however I can discern that the cells, instead of emitting the thicker threads, only lie close beside them, and that what looked like a spiral thread is only a covering of the thick thread, united with the cell and transversely wrinkled so as to look like a spiral thread (38). The thread itself tapers

somewhat rapidly towards one of its extremities. These thicker threads present themselves principally at the upper end of the organ, above the commencement of the calcareous staves, whereas the threads which surround the staves themselves are entirely destitute of covering. Flat, rounded cells, without ramifications, are found scattered in great numbers within the organ.

As regards the systematic position of this singular animal, some few remarks offer themselves, but it seems safer to defer all detailed discussion on the subject until more complete investigations will have been made. As elsewhere, embryology will give the best clue to its affinities. At present the type of Mollusca and that of Vermes seem both to claim Neomenia as a distant relation, the latter perhaps with more right than the former. Neomenia, however, presents considerable deviations from both, in the absence of a radula, in the structure of the alimentary canal and of the nervous system, as also in other respects, as the form of the body and the spines on the skin.

EXPLANATION OF THE PLATES.

PLATE I.

- Fig. 1. Side view of *Neomenia carinata* in a contracted state; natural size; *a*, mouth; *b*, anus.
- Fig. 2. Lower view of the same; *a*, mouth; *b*, anus; *c*, ventral furrow.
- Fig. 3. Upper view of the same.
- Fig. 4. Lower view of an extended specimen, natural size; *a*, mouth; *b*, anus; *c*, ventral furrow.
- Fig. 5. Side view of the same; *a*, mouth; *b*, anus.
- Fig. 6. Longitudinal section of a contracted specimen; *a*, mouth; *b*, anterior part of the pharynx entirely drawn in; *c*, posterior part of the same; *d*, stomach; *e*, transversal lamella; *f*, rectum; *g*, anus; *h*, longitudinal lamellæ in posterior part of rectum; *i*, integument; *k*, ventral furrow; *l*, vertical passage; *m*, one of the longitudinal folds in the bottom of the ventral furrow; *n*, the longitudinal canal; *o*, rudimental body-cavity; *p*, supra-esophageal ganglion; *q*, mushroom-shaped organ not cut through; *r*, section of the duct from the left lateral gland; *s*, cavity inclosing the mushroom-shaped organ; *t*, leaflike protuberances in this cavity; *u*, ovary; *v*, egg-laminæ in the ovary; *w*, transversal membranes of connective tissue; *x*, egg-bag; *y*, *z* bodies fixed on the posterior wall of this bag.
- Fig. 7. Transversal section of a contracted specimen; *α*, longitudinal muscle-bands; *β*, ventral nerve-trunks; *γ*, lateral nerve-trunks; the rest of the letters signify the same as in the preceding figure.
- Fig. 8. Inner view of the contracted pharynx; letters as in fig. 6.
- Fig. 9. Longitudinal section of the pharynx, when about to be protruded; letters as in fig. 6.
- Fig. 10. Longitudinal section of the entirely protruded pharynx; letters as in fig. 6.
- Fig. 11. Supra-esophageal ganglion.
- Fig. 12. Infra-esophageal ganglia.
- Fig. 13. Ventral nerve-trunk from an extended specimen.
- Fig. 14. The same from a contracted specimen.
- Fig. 15, 16. Nerves from the integument; *a*, pigment cells.

- Fig. 17. Spine from the ridge of the back, viewed from the grooved side.
 Fig. 18. Side view of the same.
 Fig. 19. Distal part of the same.
 Fig. 20. Grooved spine from the side of the animal.
 Fig. 21. Bridle-like spine.

PLATE II.

- Fig. 22. Radial section of the integument; *a*, homogeneous substance; *b*, *c*, cells in this tissue; *d*, longitudinal muscle-fibres; *e*, sections of muscle-fibres going obliquely outwards from the ring-muscle-layer; *f*, radial fibres; *g*, nerve; *h*, pigmented nerve-cells; *i*, bloodcanals.
 Fig. 23. Warts and spines from the surface of the integument.
 Fig. 24, 25, 26, 27. Cells from the integument.
 Fig. 28. Cells from the blood-canals.
 Fig. 29. Right lateral gland (*a*) with the common mushroom-shaped efferent duct (*b*).
 Fig. 30. Lower surface of the same duct.
 Fig. 31. Excrecences on this surface.
 Fig. 32. A transversal egg-lamina from the ovary of a large specimen.
 Fig. 33. A part of the same lamina highly magnified.
 Fig. 34. Transversal lamina from a smaller specimen.
 Fig. 35. A part of the same.
 Fig. 36. Lateral cord-like organ; *a*, upper part; *b*, lower part; *c*, *d*, branches; *e*, stafflike bodies.
 Fig. 37. Lower part of the staff-like bodies highly magnified; *a*, the conical staff; *b*, the furrowed.
 Fig. 38. Fibres from the cord-like organ.

