

Brachiopoda and Phoronida

Introduction

“They have crowns, but no head to set them on”

– Paul Illg in a lecture on lophophorates to students of invertebrate zoology.

Brachiopods and phoronids are lophophorates, along with bryozoans. They receive their name from the lophophores, or feeding tentacles, that are formed anteriorly and used to capture zooplankton from the seawater. They were classically considered deuterostomes, due to their embryonic development, and the fact that the lophophores looked very similar to the feeding tentacles of the colonial pterobranch hemichordates. They also have radial cleavage, and phoronids are tricoelomic as larvae - they have three coelomic cavities that form by enterocoely. . However, molecular phylogenetic evidence suggested that both brachiopods and phoronids have protostome affinities and current 18S rDNA phylogenies suggest that they are members of the lophotrochozoa (Halanych et al 1995). In spite of this evidence, many people still erroneously classify them as deuterostomes. In brachiopods and phoronids, gastrulation occurs by invagination and the mouth appears where the blastopore had formed and then closed again, which would suggest that they are protostomes.

Brachiopods

Brachiopods are named from the Greek words “brachio” meaning arm and “poda” which means foot. There are less than 400 species of brachiopods extant today, although there are 100 genera and 30,000 species in the fossil record. The adult is protected within two valves. There are two classes, the Articulata, which has a hinged shell and the Inarticulata, which lacks a hinge. They were thought to be mollusks until Thomas

Huxley refuted that idea in the late 1800s. Current molecular phylogenies and developmental analyses show that the brachiopods and phoronids are sister groups within the Lophotrochozoa protostomes.

Class Articulata (about 300 living species)

Order Rhynchonellidae

Order Terabratulidae

Order Thecideidina

Class Articulata (about 45 living species)

Order Lingulidae

Order Acrotretida

Suborder Acrotretidina

Suborder Craniidina

Reproduction

In brachiopods, the sexes are separate, except a few articulate species that are hermaphrodites. Most of the species known are free-spawners, but there are a couple of brooders described as well. The sperm is not the unusual type found in phoronids. The embryos have radial cleavage and a substantial blastocoel. Gastrulation begins by invagination, as seen in phoronids, and much of their developmental patterns suggest strong affinities with the phoronids, agreeing with molecular evidence that the two are sister groups. The larvae have only two coeloms, which have been called the mesocoelom and metacoelom, but it not clear if these are homologous to those of phoronid larvae.

Phoronids

There are only about 20 species of phoronids, which are classified into 2 genera that are not very distinct, *Phoronis* and *Phoronopsis*. The genus name *Phoronis* comes from the mythological character Io, whose surname was *Phoronis*. She was transformed into a white heifer and wandered far and wide before being transformed back into her original form (Kozloff, 1990). Phoronids have the ability to regenerate and frequently regenerate their lophophores, which they can pinch off if disturbed.

Reproduction

Some phoronids have separate sexes and some are hermaphroditic. It is not known whether hermaphroditic species can self-fertilize or not. In some species of *Phoronopsis* the sperm have leaf-like or spiral sails, but there are none found in the genus *Phoronis*. Gastrulation occurs by invagination. Some of the mesoderm is derived from the archenteron, some from the ectoderm. A larva forms that is called an actinotroph, with an apical tuft, a ciliated preoral hood, a set of tentacles forming an incomplete collar around the mouth, and a ring of cilia around the anus (!) The actinotroph larva has three coleoms. After metamorphosis, the larva resorbs its oral hood, obliterating the protocoel. The metasomal sac turns inside out, pulling a loop of gut with it. This results in an adult phoronid with a gut bent back on itself like a hairpin.

References

1. Halanych, K. M., Bacheller, J. D., Aguinaldo, A. M., Liva, S. M., Hillis, D. M. and Lake, J. A. (1995) Evidence of 18S ribosomal DNA that the lophophorates are protostome animals. *Science* 267: 1641-1643.