Summary

The position of the Bryozoa in the phylogenetic system is uncertain. While modern analyses of DNA sequence data place Bryozoa within Lophotrochozoa, most traditional morphological approaches argue for a common ancestry with deuterostomes. However, many characters used for this inference are only insufficiently investigated, causing problems in the assignment of character states. In the present study, aspects of bryozoan embryonic development as well as larval and adult morphology are investigated in order to enhance the morphological data set. The results are presented in five chapters which are based on two published and three submitted papers.

In previous accounts, Phylactolaemata were found to show a considerable morphological distance to Stenolaemata and Gymnolaemata. Some of their characters were interpreted as being plesiomorphic, inherited from a common ancestor of Bryozoa, Phoronida, and Brachiopoda. In chapter 2 *Ganglion ultrastructure in phylactolaemate Bryozoa: Evidence for a neuroepithelium*, earlier speculations about a hollow cerebral ganglion, which arises by invagination can be confirmed. Chapter 3 *Body cavities in phylactolaemate Bryozoa* deals with the question of trimery of coelomic cavities, which had been hypothesized as a common character of tentaculates and deuterostomes. Recent studies, however, argue to refute this for Brachiopoda and Phoronida. In addition to this, it is shown by the present results that the epistome in phylactolaemates does contain a secondary body cavity, but this is confluent with the trunk coelom. Hence, there is no trimery in Phylactolaemata.

Chapter 4 *Muscular systems of gymnolaemate bryozoan larvae* addresses the question, whether planktotrophic or lecithotrophic larvae can be regarded as ancestral for Bryozoa. Three-dimensional structure of musculature of larvae of five species, representing different types, has been investigated using fluorescence staining and confocal laser scanning microscopy. Musculature turns out to be of phylogenetic significance. In combination with existing data from the literature, the results support the idea of a multiple independent evolution of lecithotrophic from planktotrophic larvae.

In Chapter 5 *Serotonergic and FMRFamidergic nervous systems in gymnolaemate bryozoan larvae* are examined in order to facilitate comparisons with equivalent data which have become available for many lophotrochozoan and deuterostome taxa during the last years. These data have successfully been applied in phylogenetic approaches, however, the currently available data in Bryozoa are inconsistent. Larval nervous systems of different species are examined using immunohistochemistry, confocal laser scanning microscopy and transmission electron microscopy. An ancestral pattern is proposed, which shows resemblance to larval nervous systems in annelids, molluscs and kamptozoans, but not to deuterstomes, phoronids and brachiopods.

In chapter 6 *Origin of the Mesoderm in* Membranipora membranacea, embryonic stages of a planktotrophic cyphonautes larva are examined. Earlier studies on bryozoan embryology had assumed the mesoderm to originate from a quartet of cells at the vegetal pole of the embryo. Since these cells were also found to give rise to endoderm, this had been interpreted as a link to mesoderm formation in deuterostomes. However, these investigations were mostly done on lecithotrophic larvae, which are likely to be derived within Bryozoa. The present results show the mesoderm to originate by proliferation of an ectodermal cell into the blastocoel. In later stages, this cell gives rise to the larval musculature. This pattern is also present in spiralians.

The results of the present study do not support a deuterostome affinity of Bryozoa, but argue for a position in the lophotrochozoa. No characters supporting sister-group relationships to brachiopods, phoronids or kamptozoans could be identified.