Polyp Morphogenesis in a Scyphozoan: Evidence for a Head Inhibitor from the Presumptive Foot End in Vegetative Buds of Cassiopeia andromeda

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Summary. Buds of Cassiopeia andromeda have been transected into fragments of various sizes. Depending on their original position in the organism, on their size and on the age of the dissected buds, the fragments either regenerated or developed to a solitary polyp's head without stalk and peduncle. Generally, basal fragments tended to regenerate complete buds, young apical parts mostly differentiated polyph heads whereas apical and middle parts of progressively older buds regenerated buds with increasing frequency. To explain the alteration of the developmental capacities a head inhibitor is postulated which originates from the basal end of the buds and which expands towards the apical pole with increasing age of the buds.

Key words: Coelenterates — Cassiopeia andromeda — Vegetative buds — Polarity — Head inhibitor.

Cassiopeia andromeda Forskal (Rhizostomae) exhibits typical metagenetic development. Sessile scyphistomae representing the vegetative generation form medusae by monodiscous strobilation and these reproduce sexually to give rise to polyps via a planula stage (Bigelow, 1900; Gohar and Eisawy, 1960). In addition, ciliated vegetative buds produced in particular areas of the head region of the scyphistomae (Fig. 1) transform into polyps after settling down on a suitable substrate. When the buds detach from the polyps, their organisation is already polarized: the site of attachment is the future apical region which gives rise to the head of the new polyp, while the opposite pole represents the presumptive foot region. About 4 days after detachment from the polyp the free-swimming buds develop 4–5 short tentacles and a hypostome. The fixation of the agile bud and the successive transformation into a scyphistoma are obviously mediated by the influence of particular marine bacteria. In sterile media or in media containing antibiotics the formation of polyps is inhibited (Hofmann, Neumann and Henne, in preparation). As an unexpected result of transection, polyp heads without foot and stalk developed from certain fragments of buds (Curtis and
Fig. 1. A Budding scyphistoma of Cassiopeia andromeda. B Newly detached bud. C Four-day-old bud. 
ap apical pole, b bud, bd basal disc, bp basal pole, h head, hy hypostome, s stalk, t tentacles

Cowden, 1971; Henne, 1975). The present paper therefore attempts a first approach to the mechanisms controlling the organisation of the buds.

For the experiments, detached buds were collected twice a day from numerous Boveri dishes, each containing 15 full grown scyphistomae in 150 ml pasteurized natural sea water. The polyps were kept at 25°C for a long day (16L/8D) and fed with brine shrimps three times a week. Several hours after feeding the sea water was changed. Buds were transferred into dishes with sea water containing antibiotics (100 mg penicillin + 129 mg streptomycin per 1000 ml pasteurized sea water); at the appropriate age, they were anaesthetized in an isotonic MgCl2-solution and dissected under a dissection microscope. Thereafter the fragments were usually kept in pasteurized sea water and checked daily. The results were recorded 8 days after transection.

Following longitudinal section of the spindle-shaped buds, both parts were able to regenerate complete but somewhat smaller buds within 24 h. They transformed into polyps when exposed to the above-mentioned bacterial influence.

If buds were sectioned transversely, the apical and the basal fragments developed quite differently. Apical parts frequently formed heads without stalk and foot, even in sea water containing antibiotics, whereas basal parts tended to regenerate buds but never formed head structures. Similar observations have been reported by Curtis and Cowden (1971) and by Henne (1975).