The Umbrellar Growth Process in the Leptomedusae *Phialidium hemisphaericum* (Syn. *Campanularia johnstoni*)[1]

The *Hydrozoa* (*Coelenterata*) frequently exhibit a reproductive cycle, in which an asexual generation (hydroidpolyps) alternates with a sexual generation (hydromedusae). In spite of the identical genetic background and the presence of embryonic cells (interstitial cells), the lifespan of polyps and medusae are markedly different[2]. Experiments concerned with the growth and regenerative processes of hydroidpolyps[3-7] revealed an almost unlimited regenerative power and have shown that these animals can be considered as being somatically immortal[8], as long as normal culture conditions are guaranteed. The life span of the medusae, on the contrary, is limited in time, although the regenerative capabilities are comparable to those of the polyps[9,10]. In this connection we might ask what kind of factors are responsible for the lethal crisis to which the medusae are subjected after having shed their gametes? Is it sexuality as such, or perhaps the absence of a mechanism which, as is the case in polyps, takes care of a constant replacement of the cell

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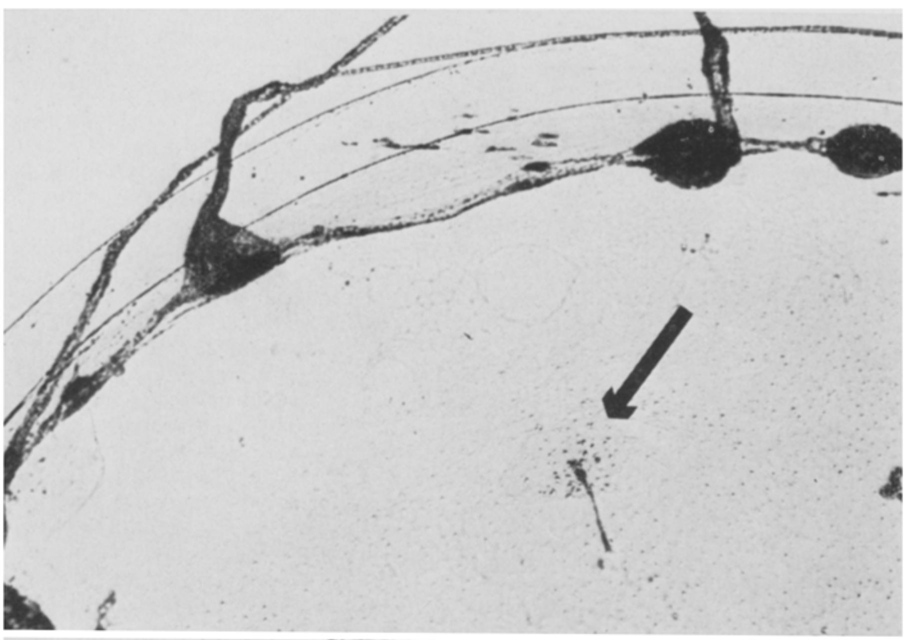
a)



b)

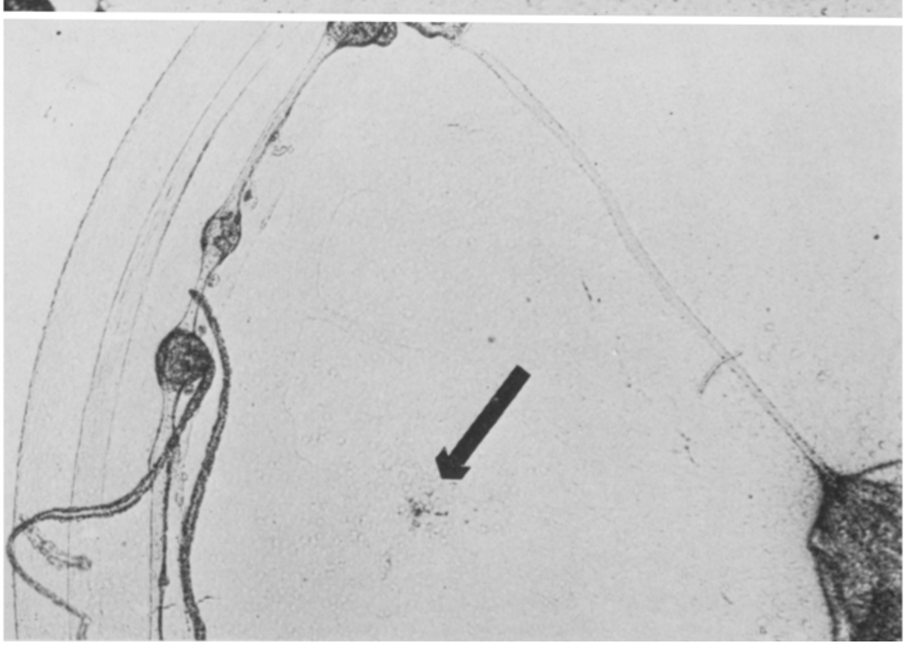


Fig. 1. Marker of Bismarck-brown a) in subumbrellar tissue 12 h after injection, and b) in exumbrellar tissue 96 h after injection, ×20.

populations? These considerations constitute the background of this short note which investigates the process of normal growth in hydromedusae.

Material and methods. The metagenetic species *Phialidium hemisphaericum* (Thecaphorae) was cultured in our institute as described by BAUMANN (1970, personal communication). The growth process of the medusae of this species, kept at room temperature, was accelerated by feeding them twice a day with freshly hatched nauplii of *Artemia salina*.

In order to obtain information on the growth pattern of the ex- and subumbrellar tissues, selected areas of these tissues were labelled with the vital dye Bismarck-brown. The subsequent displacement of these markers was taken as an index of growth. The dye was injected into the umbrella with a microcapillary (diameter 0.05 mm) and it remained visible throughout the experiment (at least 7–10 days). Initially, the label was seen randomly distributed within the mesogloea. On the following day, the dye was usually expelled by the mesogloea into the ex- and subumbrellar tissues where it formed distinct patches (Figures 1a and 1b). An estimation of marker displacement was determined by employing 3 coordinates: x as the distance from the marker to the manubrium, z as the distance from the marker to the ring canal and y as the distance from the marker to the radial canal (Figure 2). The 3 coordinates were measured daily on the umbrellar tissues by turning the meduses upside down, for the measurements in the subumbrellar tissues. Streptomycin (0.1 mg/ml) was added to the culture medium immediately following the injection of dye as a bactericide.

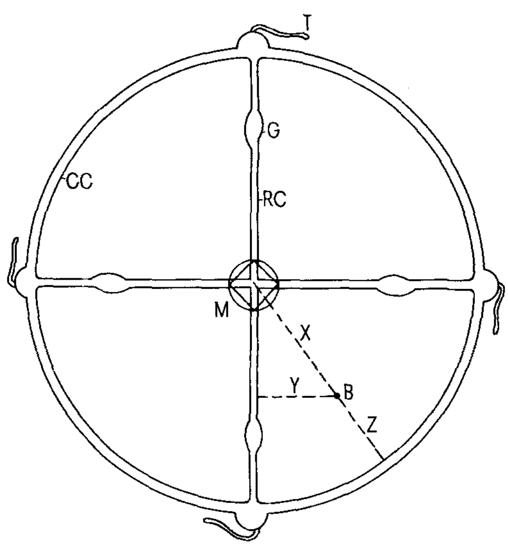


Fig. 2. Scheme of medusae showing coordinates of measurements. B, vital dye Bismarck-brown; CC, circular canal; G, gonads; M, manubrium; RC, radial canal; T, tentacle; x, y and z, coordinates.

Increase of x, y and z in the umbrellar growth process

Animal No.	Time from injection (days)	x	z	y
a)				
1	5	+5	+34	+2
2	6	+6	+41	–
3	6	−3	+18	–
4	4	+2	+ 9	+1
5	6	+8	+19	–
b)				
1	11	+5	+20	–
2	5	+3	+20	–
3	6	+1	+29	–
4	9	+5	+25	–
5	6	+9	+16	1

a) Growth measurements with reference to marker for exumbrellar tissues. b) Growth measurements with reference to marker for subumbrellar tissues. x, y and z-values are expressed in units; 20 units are similar to 1 mm.

Results. The values listed in the Table show a strong increase of the coordinate z, whereas the increase of the coordinate x was not so accentuated. The coordinate y, on the other hand, remained stable throughout the experiment. The displacement of the 3 markers was identical in the subumbrellar and the exumbrellar tissues, indicating same rates of growth in both tissues.

Discussion. The results show that, in the medusae of *Phialidium hemisphaericum*, the region of active growth is situated at the margin of the umbrella in the vicinity of the circular canal. This 'growth region' forms the tissues of the sub- and exumbrella of the growing medusae.

A certain error in measuring cannot be excluded as non-anaesthesized animals do more or less change the shape of the bell during the measurements. For this reason we believe that the growth rate expressed by the change of the coordinate x is of a low significance.

The results are in contrast to the available informations concerning the growing pattern of polyps[3–7], where the body column is subjected to a continuous process of growth and where cells and tissues migrate from proliferating areas to the areas where cells are sloughed off (tentacles, buds etc.). Indeed, this activity may possibly be the main reason for the apparent somatic immortality of the polyp. As demonstrated in this paper, no such migrations seem to take place in the umbrellar tissues of the medusae. The active growth region in the medusae is confined to the edge of the umbrella and this important difference between the behaviour of growth and tissue migration in polyps and medusae may be responsible for the different lifespan.

Zusammenfassung. Das Wachstum der umbrellaren Gewebe bei der Hydromeduse *Phialidium hemisphaericum* wurde durch lokale Anfärbung mit dem Vitalfarbstoff Bismarckbraun untersucht. Die Wachstumsregion, welche ex- und subumbrellare Gewebe bildet, liegt am Rande der Medusenglocke in der Nähe des Ringkanales. Gewebewanderungen konnten keine festgestellt werden. Die möglichen Folgen der unterschiedlichen Wachstumsvorgänge bei Polyp und Meduse werden diskutiert.

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