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Strobilation of Chrysaora quinquecirrha polyps in the laboratory

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Abstract—The scyphistoma of *Chrysaora quinquecirrha* was induced to strobilate in the laboratory. Detailed description of the process is given.

Just prior to strobilation, the goblet-shaped polyp undergoes color change and clefting. Each scyphistoma typically releases five ephyrae. Terminal tentacles are resorbed during strobilation and appear near its completion at the base of the strobila.

Upon release, ephyrae swim to the surface and attempt to maintain their position there. Strobilation is normally complete in 20-25 hours after clefting. All stages survive well on *Artemia*, enchytraeids, ground ctenophores, and similar food.

During a long-range study of the Chesapeake Bay sea nettle *Chrysaora quinquecirrha* DeSor, strobilation of the polyp was induced and the entire process observed. The present paper presents details of timing and behavior not given by Littleford (1) in his account of strobilation. Notable articles dealing with this process in other species include those of Spangenberg (2, 3) for *Aurelia* and Kakinuma (4) for *Dactylometra pacifica*.

Polyps utilized in this investigation were obtained from oyster shells dredged at Roane Point in the York River, Virginia. Shells were obtained during January, when water temperature ranged from 3 to 5° C and salinity from 12 to 15 parts per thousand (o/oo). Shells with 83 attached polyps were cleaned of extraneous fouling and held at ambient temperature in a 20 liter Plexiglass aquarium. Salt water was allowed to flow during the day, but the flow was shut off during the night to facilitate feeding the polyps with *Artemia*.

After a two week period of acclimation, the aquarium was enclosed in a three inch thick cube of styrofoam. An air tube and thermometer were placed in the aquarium and the salt water flow was cut off; salinity at this time was 18.4 o/oo. Temperature of the standing water was allowed to rise gradually at the rate of about 1.5° C over a period of about 10 days. When the temperature reached 17° C, supplemental heating was necessary to raise the temperature to 20° C. When the water temperature reached 20° C, about 12 days after heating started, strobilation began and continued over a period of about two weeks.

Strobilation ceased if the temperature was decreased suddenly to 3 to 5° C, and the polyps gradually returned to the typical overwintering form. Strobilation could again be induced in the same individuals by heating the water as previously outlined. The present study was carried out with polyps that had been previously strobilated.

The normal polypoid form of *Chrysaora quinquecirrha* possesses 16 long, knotted tentacles surrounding a raised mouth. Normal polyp height ranges between 0.8 mm and 2.0 mm. The slender base of the goblet-shaped body broadens at the bottom to form a basal disc (Fig. 1).

Several days prior to strobilation, a definite color change occurred in the polyps. Their typical off-white color changed to pale pink and then gradually deepened to red or crimson. During this color change, and approximately 72 hours before the budding off of the first ephyra, visible clefts began to appear at five points radially along the length of the polyp (Fig. 2). Within 24 to 48 hours the clefts deepened until five distinct discs became visible, each connected to the other by a thin filament. Discs were smaller near the base of the polyp, the terminal disc being ⅓ larger than the disc directly beneath it. With the deepening of the clefts, terminal tentacles on the polyp were resorbed (Fig. 3).

With the formation of the discs, each developed eight bifid "arms" (which later form part of the bell) and began spasmodic pulsations. The characteristic jerking motion of strobilation did not occur in the entire polyp but only in the terminal disc. Pulsations were similar to those of the normal free-swimming ephyra. The contractions varied in number from a single pulse to five or six in succession. The total series took between three and five seconds.

Approximately one hour before separation of the terminal disc, the disc immediately beneath it began to enlarge and pulsate, often in unison with the terminal disc.

Each strobile disc required at least four hours to separate. Since five discs were present on each polyp, 20–25 hours were required for the completion of strobilation of a single polyp after clefting.

When only two strobile discs remained, polyp tentacles began to reappear beneath the last disc and

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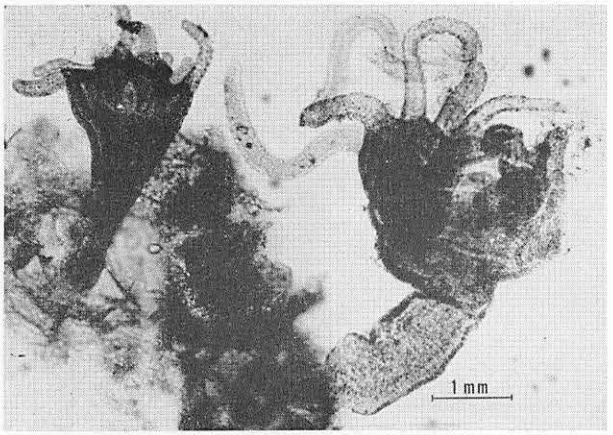

FIG. 1—Normal polyp of *C. quinquecirrha*. Tentacles clumped due to preservation and mounting.

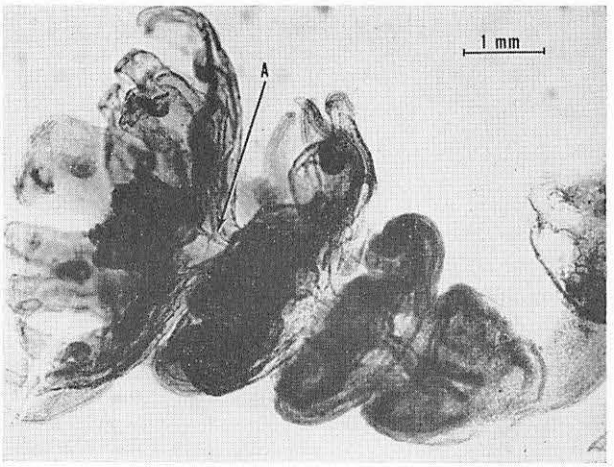

FIG. 3—Strobilating polyp with 4 developing ephyrae. A = attaching filament.

enlarged throughout the strobilation of the remaining ephyrae. The tentacles were near normal size when the last disc had separated. The pulse period for the last disc was usually somewhat longer than for the previous four, being three to eight seconds in duration. Contraction rate was normal immediately before separation. The pulses continued until disc separation was completed. Polyps assumed normal appearance 24–72 hours after separation of the last disc.

All polyps observed produced five ephyrae each, with the exception of one which produced six. After strobilation many of the polyps gave rise to stolons, and there was a general increase in colony size.

During clefting of the polyp, the discs were separated by a clear stalk, with a central bright red fiber. (Fig. 3). Although the stalk appeared thick there was a cleft in the clear portion and the actual connection was by the red fiber only. As the terminal disc pulsated, the fiber holding it to the others became very thin and finally parted as the ephyra broke free. The remaining clear, thick portion of the stalk appeared to become the manubrium of the next ephyra. Several hours before separation this manubrium-like structure began to twitch and infolding occurred (Fig. 4).

The newly-strobilated ephyra was inverted when compared to the adult, swimming with the manubrium in a dorsal position rather than a ventral one. The body was light pink with several very prominent deep-red regions (Fig. 5). The red portions were the tentaculocysts, the manubrium, and the tips of the bifid arms. Lambert (5) believes the intensity of this color is dependent on the intensity of the light reaching the polyp at the time of strobilation. At the time of release, the ephyra had no tentacles and propelled itself with a series of rapid pulses (five or six) alternated with slight pauses that equaled in duration two or three contractions. Each pulse propelled the ephyra approximately 0.75 mm.

Immediately after release from the polyp, ephyrae moved to the surface of the container and attempted to maintain their position there. Lambert (5) has suggested this to be a phototactic response.

Approximately 96–120 hours after release, the red portions of the ephyra became more prominent and the remaining portions began to clear. In about

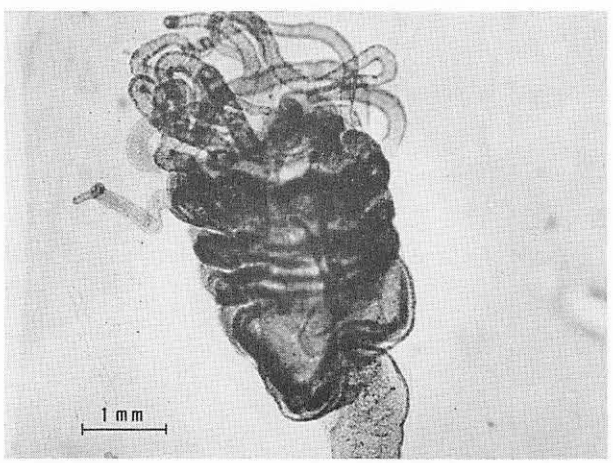

FIG. 2—Polyp in early indentation stage of strobilation.

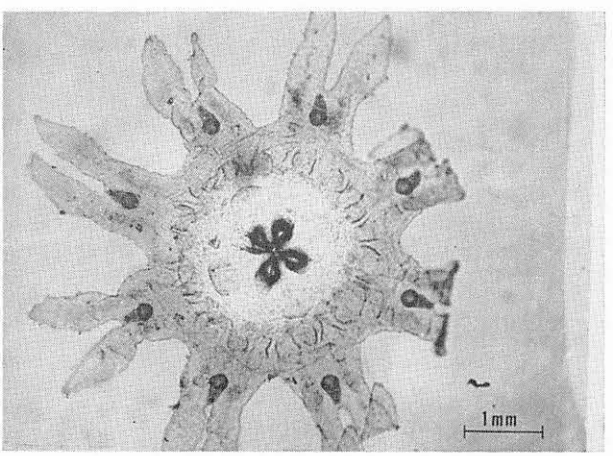

FIG. 4—Ephyra showing the infolded manubrium.

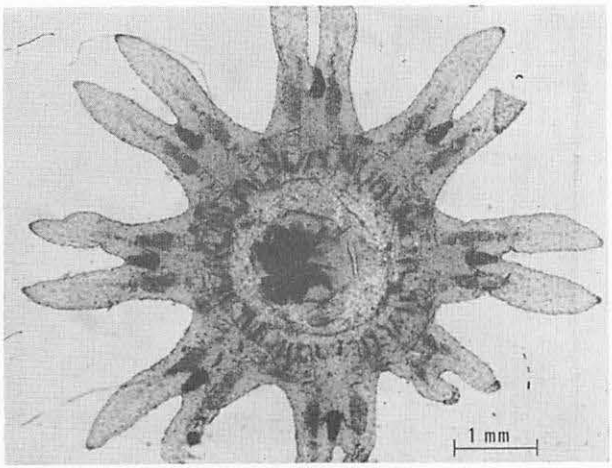

FIG. 5—24-hour ephyra.

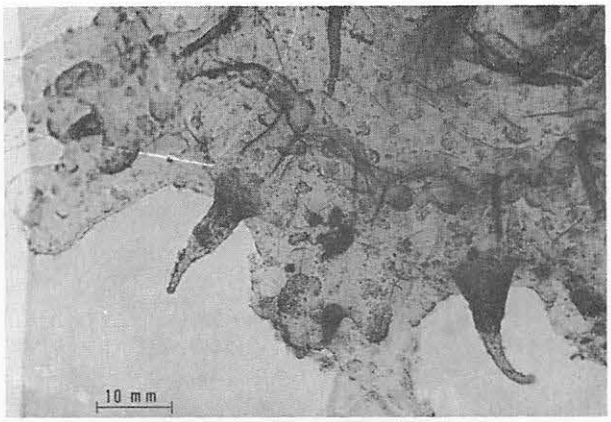

FIG. 6—240-hour ephyra showing advanced development of bell and primary tentacles.

two weeks, the area between the bifid arms was filled in, the bell everted, and the red regions faded as the animal assumed its adult milky-white color (Fig. 6).

All developing stages were found to ingest a wide variety of organisms. Foods shown by other authors to be acceptable for coelenterate life stages include *Artemia,* plankton, liquid *Nereis,* small nereids, *Dendroboena subrubicunda, Obelia,* young jellyfishes, small copepods, *Clione, Limacina,* and hamburger, (1, 2, 5–8). During the present investigation, all stages fed actively on *Artemia,* enchytraeids, polychaeta larva, and strained ctenophores. Lambert (5) found the ephyrae of a British species of *Chrysaora* to be cannibalistic. He also found ctenophores to be the only food accepted by *Chrysaora* ephyrae larger than ⅓ inch.

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