

# PHOTOPERIODICITY IN THE SPAWNING REACTION OF *PENNARIA TIARELLA* McCr.

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The phenomenon of photoperiodicity has been the subject of an increasing amount of attention over the last few years. It was first seriously studied by Garner and various others beginning about 1920. He coined the word for use with reference to flower production in relation to light in various plants. He divided plants into three groups: (1) "short-day," which bloom only in a light day of 12 hours or less, (2) "long-day," which bloom only when the light day is longer than 12 hours, and (3) "everblooming," which are able to bloom under a wide range of light conditions. While he found various vegetative responses to light in various plants and plant groups, flowering, the reproductive process in plants, seemed to be almost universally and directly controlled by light.

Since this time various phases of the reproductive process in animal groups, particularly the time of the shedding of the gametes, have been found to have a direct photoperiodic relation. Probably the most work in this line has been done by Bissonnette, who has demonstrated a direct seasonal photoperiodicity in gonadal activity in both starlings and ferrets.

*Pennaria tiarella* McCr. is a quite typical colonial marine hydroid of the family Tubulariæ. It has an alternation of sexual and asexual generations, but the sexual medusæ are somewhat reduced in importance in the life cycle. The polyp, or asexual form, is quite typical, growing in colonies attached to *Fucus* or other sea-weed or attached to pilings about three feet under the water level. Individual stalks, unless the colony is too dense, are rather feather-like in form, being branched alternately and with a single hydranth at the end of each branch.

The medusæ, or sexual individuals, grow attached to the hydranth about midway between the upper and lower rows of tentacles. As many as three medusæ may develop on one hydranth. The medusa, though somewhat degenerate, is small but typical. It has a small velum but no tentacles. Sexual products mature in the medusa attached to the manubrium and are discharged by the contractions of the velum and bell, complete discharge often taking as much as two hours. Fertilization and development are typical. The medusæ may break loose from the hydranth and swim about before they discharge the eggs and sperm, but more frequently, under laboratory conditions at least, they discharge before breaking loose. After discharge the medusæ degenerate rapidly.

The season for *Pennaria* is rather long. This year the first mature eggs were obtained July 2, and they were still plentifully available when the work was discontinued September 12. The sexual products are discharged by the medusæ between the hours of 8 and about 11 p. m. This time is practically constant either in nature or under laboratory conditions.

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The cause of this daily periodicity has never been demonstrated. Water temperature is not a significant factor in view of the fact that there is no appreciable change in spawning time throughout the entire season. Tide is not significant, as tide times change constantly throughout the year, and spawning takes place quite as regularly in a dish of running sea water in the laboratory as in the ocean. Though this daily periodicity would suggest light as a significant factor, G. T. Hargitt (1900) reported that light conditions had no effect on spawning.

Experimental results obtained this summer at the Marine Biological Laboratory definitely indicate, however, that light is a significant factor in controlling the spawning reaction. *Pennaria* was placed in running sea water in dishes that had been painted with black Duco to exclude all stray light. These were then placed under 75-watt clear lamps which were curtained with black cloth, again to exclude the stray light. The cloth curtain was then tied tightly around the dish. Under these controlled conditions spawning could be produced practically at will at any hour of the day or night simply by varying the light conditions.

It was definitely indicated that light conditions during the growth period of the medusae buds, rather than at the time of spawning, constitute the controlling factor. Relatively ripe medusae from fresh material will spawn at the normal time regardless of whether they are put under the light for an abnormally long time or placed in the dark much earlier than normal. But, if the material is selected so that it contains all or mostly young, immature buds, the spawning time of these can be regulated practically at will by regulating the periods of light and darkness. Likewise the spawning of immature buds is completely inhibited by continuous darkness and almost completely inhibited by continuous light. To get any appreciable percentage of immature medusae to mature and spawn it is necessary to have some sort of a fairly regular alternation of the periods of light and dark.

There is little in the data at hand to indicate anything as to the nature of the mechanism involved in this light reaction. Hasty examination of the data indicates that spawning usually takes place between 20 and 28 hours after the beginning of the last preceding dark period. This may happen even though the animals are under a strong light at the time. A few attempts were made to discover a differential effect as between light of the various wave lengths, but as yet, anyhow, no significant difference has been detected.

#### Bibliography

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