were computed and compared. Animals trained to avoid mushroom take significantly smaller meals of mushroom (69 percent of control), whereas animals trained to avoid cucumber eat the same size meal of cucumber as do controls. This suggests that for the mushroom the plasticity is expressed both as a reduced efficacy of olfactory stimuli in initiating feeding and a reduced efficacy of gustatory stimuli in maintaining feeding, whereas for cucumber only the altered effectiveness of olfactory input is apparent.

Slugs are first alerted to the presence of potential food plants by olfactory cues (*10*). As the slug approaches food, the superior and inferior tentacles bearing olfactory receptors explore its surface closely. If the odor signals acceptability, the lips are everted and applied to the food. With the food items used in this study, control slugs invariably show radular rasping and ingestion following lip contact. Conditioned slugs occasionally move away after lip contact, but the more typical avoidance response is rejection based on olfactory cues alone. If conditioned slugs start eating the unsafe food, they consume a normal meal if it is cucumber, and a subnormal but substantial meal if it is mushroom.

Several parametric features of the learning experiment are critically important in determining the rate and duration of learning. The animal's hunger level, the nature of the aversive stimulus, and the attractiveness of the novel, unsafe food all interact to influence the level of learning achieved. My initial attempts to train slugs to avoid a highly attractive dog food by mixing the slug-poison metaldehyde into the dog food were unsuccessful, even though the slugs became very sick after ingesting small amounts of metaldehyde. It is possible that bitter tastes and surface irritants help to promote learned food aversions.

Plants contain a variety of noxious secondary substances such as cyanogenic glycosides and chlorogenic acid (*11*). In plants polymorphic for the concentration of these substances in leaf tissue, slugs preferentially feed on the morph with lowest concentration. It will be interesting to determine if ingestion of a plant containing a noxious secondary substance will alter later food selection.

Neural circuits involved in feeding behavior have been examined in a variety of gastropod mollusks, including *Limax* (*12*). The buccal ganglia contain the motoneurons responsible for radular rasping and ingestion. Chemical and electrical synaptic interactions among buccal motoneurons have been described, and some cerebral cells which synaptically excite the motoneurons have been identified. In *Limax*, olfactory input arises in the digitate ganglia of the superior tentacles and projects to the cerebral ganglia, as does gustatory input from the lips. A neurophysiological analysis of synaptic plasticity in *Limax* feeding circuitry is now feasible. It is further encouraged by the demonstration that in the gastropod *Pleurobranchaea* a neurophysiological correlate of learning could be found in vitro with brains from animals whose feeding response had been previously conditioned (*13*).

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14. Supported by NSF grants GB 20762 Al and BMS 74-035 72 and a fellowship from the John Simon Guggenheim Memorial Foundation. Donald Kennedy generously provided critical comments and laboratory facilities for some of this work.

31 March 1975

Sea Anemone with Zooxanthellae: Simultaneous Contraction and Expansion in Response to Changing Light Intensity

Abstract. *Under increasing intensity of light, the normal tentacles of* Lebrunea *contract whereas the pseudotentacles expand; in decreasing light the reverse is true. This behavior may be correlated with greater numbers of zooxanthellae in the pseudotentacles. Simultaneous but opposite response of parts suggests adaptations toward photosynthesis by day and predation by night.*

Many genera of sea anemones contract in strong light (*1*), whereas only a few expand in response to the same stimulus (*2*). There appears to be no record of an actinian (or coelenterate) which simultaneously expands and contracts different body regions in response to changes in light intensity. Such a behavior pattern has been found, however, in the aliciid anemone *Lebrunea coralligens* H. W. Wilson 1890 (Fig. 1).

Lebrunea coralligens is a common inhabitant of shallow marine waters of the Caribbean. This anemone occupies small

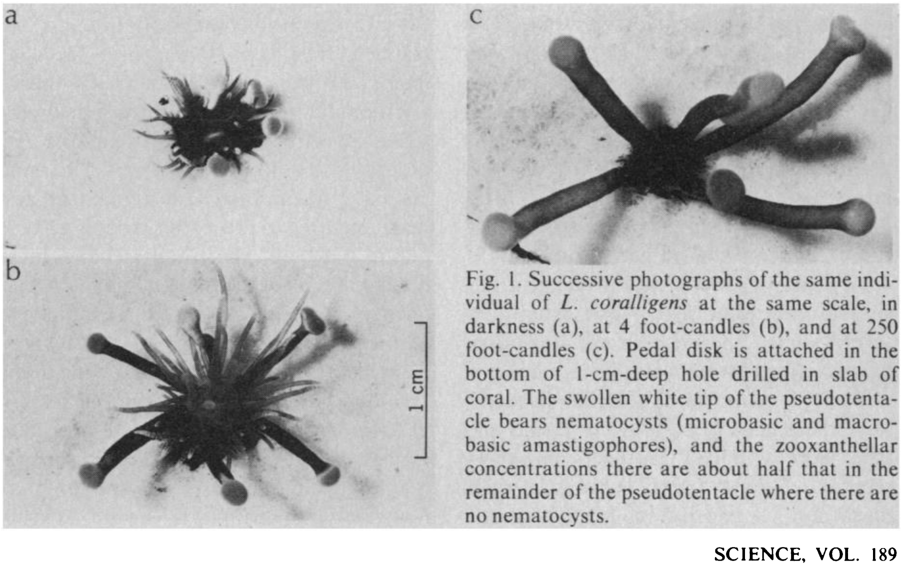

Fig. 1. Successive photographs of the same individual of *L. coralligens* at the same scale, in darkness (a), at 4 foot-candles (b), and at 250 foot-candles (c). Pedal disk is attached in the bottom of 1-cm-deep hole drilled in slab of coral. The swollen white tip of the pseudotentacle bears nematocysts (microbasic and macrobasic amastigophores), and the zooxanthellar concentrations there are about half that in the remainder of the pseudotentacle where there are no nematocysts.

dark cavities with restricted apertures in carbonate substrates such as pitted and bored dead coral heads (*Montastrea*, *Diploria*), fused heads of dead *Porites porites*, perforated encrusting coralline algae, and dead, broken conch shells. The body of the anemone is always concealed within the cavity, often to depths of several centimeters. During the day large lobate extensions of the uppermost part of the column [called pseudotentacles by Hyman (*3*), in the related *L. danae*] project from the cavity. As ambient light decreases in the late afternoon, the pseudotentacles slowly retract, and the true tentacles are extended. In the morning the tentacles are withdrawn and the pseudotentacles reextended. This behavior pattern persists in outdoor laboratory aquariums.

The behavior is apparently a direct response to light conditions and is not linked to a circadian system. In order to determine this, animals were maintained in running seawater in laboratory tanks under controlled light conditions for periods of 24 hours. Those animals that were maintained in the light (250 foot-candles; 1 foot-candle = 1.1 lu/m^2) for 24 hours remained with expanded pseudotentacles and retracted tentacles for the duration of the experiment. Those maintained in the dark for 24 hours exhibited the opposite condition.

The response was a graded one, its magnitude depending on the magnitude of the stimulus (light intensity). In order to quantify the response, the following experiment was performed on 15 animals. Each anemone was set in a small hole drilled in a cut coral slab; it was allowed a day to recover and was then subjected to a series of light intensities from incandescent bulbs increasing from darkness to 1 foot-candle and then by steps of quadrupled intensity up to 500 foot-candles. The animals were left at each light intensity for 1 hour and photographed; then the intensity was increased. The resulting photographic negatives were projected at a constant scale and traced; measurements were then made of the degree of extension of the tentacles and pseudotentacles at each intensity. The results (Fig. 2) indicate that the threshold intensity was less than 1 foot-candle. The pseudotentacles extend and swell with increasing light, reaching maximum extension at about 500 foot-candles. The tentacles are partly extended in the dark, but reach maximum extension at about 4 foot-candles (Figs. 1 and 2), which is the light intensity in their native habitat just after sunset and just before sunrise. Pseudotentacles of animals subjected to decreasing light intensities tend to remain slightly more extended at lower intensities than they did at the same intensities during the increase in light. An additional response of the tentacles of *L. coralligens* which should be noted here is that when the attachment of the basal disk to the substrate is broken, regardless of light intensity, the tentacles are greatly extended (Fig. 2).

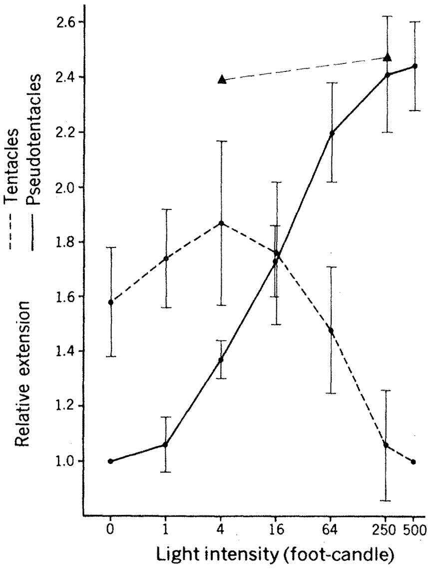

Fig. 2. Relative degree of extension of tentacles and pseudotentacles (ordinate) under a regime of periodically increased light intensities (abscissa); $n = 15$, confidence limits for $P = .10$. Calculated from measurements made on photographic negatives projected at a constant scale. For each animal, the 20 longest tentacles were measured at each interval; the same pseudotentacles were followed in each animal; a minimum of four animals (up to six when possible) was used. The width of the confidence limit markers indicates differences in the amplitudes of extension of different animals, not differences in the basic trends of the curves. The two triangles above indicate the condition of the tentacles (20 longest per animal; $n = 5$) shortly after contact between the pedal disk and the substrate is broken.

There is a real division of labor between these two tentacle-like structures in *L. coralligens*. The diurnally expanded pseudotentacles are packed with zooxanthellae in average densities of about 10,000 ± 1200/mm^2 (mean ± S.D.), whereas the extended tentacles have densities of about 3000 ± 600/mm^2. The surface area of an extended pseudotentacle is six to ten times greater than that of an extended tentacle (Fig. 1), resulting in total zooxanthellar counts being roughly 20 to 30 times greater in a pseudotentacle. It is possible that the anemone is deriving some nutritive benefit from zooxanthellar photosynthesis, as has been demonstrated, for example, in the anemone *Anthopleura elegantissima* (*4*). It has been shown by Pearse (*2, 5*) that *A. elegantissima* without zooxanthellae appear indifferent to light, while those with the symbionts show a variety of responses to different light conditions. Perhaps the greater sensitivity and reliability of the pseudotentacle response in *L. coralligens* is related to the much higher numbers of zooxanthellae in these structures.

Although topographically adjacent, the tentacles and pseudotentacles represent two different body regions (capitulum and column, respectively) which may not be in direct (nervous) communication. The column of the anemone *Calliactis* has been shown to have three separate conducting systems (*6*). Thus it may be that the opposite responses shown by tentacles and pseudotentacles to changes in light intensity are mediated by separate and largely isolated conducting systems. The graded nature of the response is typical of many coelenterate responses (*7*).

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15 April 1975

Local-Regional Anesthesia During Childbirth and Newborn Behavior

We are deeply concerned with the possible response of the lay public to the conclusions of the Standley *et al.* report (*1*) on the effect of local-regional anesthesia during childbirth on newborn behavior. The authors are not anesthesiologists and appear to be unfamiliar with the mechanism of action of obstetric anesthesia. Most important, they conclude that there may be a local anesthetic drug effect in neonates whose mothers received spinal analgesia. However, the amount of local anesthetic drug used in spinal block is so small that placental transfer has not been detected. According to Greene (*2*), "... spinal anesthesia has no direct effect on the fetus. This