

Observations on the Luminescence of the Landsnail,
Quantula striata, and its Life History⁽¹⁾

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(With 1 Plate)

発光カタツムリ *Quantula striata* の発光と生活環

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The existence of a luminous species among the terrestrial gastropods Pulmonata was not known until 1942 when *Quantula striata* (syn. *Dyakia striata*) of the Zonitidae was discovered by one of us (Y. H.) in Singapore.

Since then, Bassot, in 1968, has discovered another species of luminous landsnail, *Hemiplecta weinkauffiana*, in a jungle in Cambodia. The position and construction of the luminous organ of this species are similar to that of *Quantula striata*.

It was previously reported in April, 1960, that 75 specimens of *Quantula* were collected in Singapore and that some of these were brought back to Japan, kept alive, and studied for about 4 months. On a subsequent visit to Singapore in September, 1961, it was discovered that the mantle and foot of *Quantula* were luminous. The luminosity of these structures was previously unnoticed and was not reported in the paper of 1946.

In May, 1968, specimens of *Quantula* were again collected in Singapore and some of them were brought back to the Yokosuka City Museum in Japan for cultivation and study.

The purpose of this paper is to present further observations on the luminescence, culture, and life history of *Quantula*.

A total of 110 adult specimens of *Quantula striata* were collected in May, 1968, in Singapore, for the purposes of this study. The specimens were collected on a lawn alongside a *Hibiscus* hedge near the National Library. After being shipped to Japan in the middle of June, the snails were placed in a terrarium in a laboratory of the Yokosuka City Museum. The terrarium consisted of a glass enclosure with grass and some weeds growing on a bed of soil (resembling a miniature greenhouse). The snails were maintained on a diet of cucumbers, eggplant fruit, raddishes, carrots, and other vegetables. *Quantula* is omnivorous and has been known to feed on dead muscles of the giant snail, *Acatina frica*.

In the middle of August, 42 small larval snails were counted in the terrarium. These

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measured about 1.0 mm. in shell diameter. It was then observed that *Quantula* spawned white eggs in the soil. The eggs had the appearance of an ellipsoid and the major and minor axes were approximately 1.0 mm. \times 0.8 mm., respectively. About 10 days after the egg was spawned, an embryo developed within the egg. The embryo emitted a weak, continuous light that was recognizable through the translucent shell. A week later a small larval snail was hatched.

Immediately after being hatched, the young snail (about 1.0 mm. in shell diameter) emitted what appeared to be a weak, continuous light over the whole surface of the foot. When the foot was examined under low power magnification, the entire surface had a diffuse glow. The luminescence seemed to be produced by many individual flashes of light. As the snail developed, the luminescence condensed to an oval luminous organ just below the mouth.

The principal luminous organ of *Quantula* was found to be located beneath the mucous fold of the head. It was oval in shape and was not visible from the surface. As previously noted, two other structures were found to be luminous: the whole mantle and the foot. The luminescence of the mantle and foot, however, differed from that of the main luminous organ in that the light was continuous and very dim, so as to be almost invisible. This weak light was discernible only to the dark-adapted eye in a completely darkened room. Further, *Quantula* was found to luminesce almost exclusively only under natural conditions.

After being kept at a temperature between 20–26°C for about two months, the larval snail grew into a young snail of about 5.0 mm. in shell diameter. During this period of growth, the frequency of individual luminescence was the greatest. The luminescence was intracellular and luminous slime was not secreted by any of the luminous cells. After two months, the snail grew into an adult. The adult snail was practically non-luminous, but its ability to luminesce was found to be an individual characteristic. The luminescence of *Quantula*, therefore, appears to be confined almost exclusively to the egg, the larva, and the young snail.

Preliminary attempts were also made to preserve the luminescent system for biochemical studies, but the results were unsuccessful. When a living specimen of *Dyakia* was frozen with dry-ice and then brought back to room temperature, luminescence did not reappear. Also, the luminous tissue of *Quantula*, after drying, did not luminesce when moistened with water. The luminescent system, therefore, appears to be very sensitive to destruction following the death of the animal.

抄 録

発光カタツムリ *Quantula striata* の発光についてはすでに報告したが、このカタツムリの発光は極めて特異であって、他の多くの発光動物のように、刺激によって光ることはなく、発光は殻より体を伸ばして温度、湿度などの最適の場合にのみ光るのである。また、殻の直径 6.0 mm 程の幼弱な個体がよく光り、成長しきった個体ではほとんど発光をみられなかった。したがって、カタツムリの発光の状態をさらによく観察すると共に飼育して、その生活環を知ると共に、どの時期に最もよく光るかを観察した。1968年5月シンガポールで採集した110個体は全部、成貝であった。この中、発光する個体は僅かに1個体に過ぎなかった。

同年8月中旬、この発光しないカタツムリより殻直径 1.0 mm の幼貝が生れ、いずれも例外なく発光した。9月に、飼育器の土中より楕円形の白色の卵、数十個を発見、暗室で観察すると白い半透明の殻を通して、弱

い連続的な光を放つのをみた。

卵は産卵後、約 10 日で卵の中に幼貝が出来、この頃から連続的な光を放ち、さらに 1 週間—10 日位で幼貝となるが、腹足全体から弱い光を放ち、さらに生長して、1.2—1.5 mm 位になると光は明滅するようになり、口の下部の筋肉中に発光器が出来る。この幼貝は 1—2 ヶ月で殻の直径 5.0 mm ぐらいになるが、この時ほとんど例外なく、口の下の主発光器が明滅する。さらに 2—3 ヶ月で殻の直径 20.0—22.0 mm の成貝となるが、段々と発光回数が減少し、ついには発光しなくなる。成貝の中には、腹足全体と外套膜が弱い連続的な光を放つ個体もある。

ニュージーランドの淡水の発光貝 *Latia neritoides*, あるいは海産の発光巻貝 *Planaxis* では冷凍後、常温にもどして光るので、このカタツムリについて、冷凍および乾燥によって光が失われるかいなかを試みたが光は再び回復させることは出来なかった。したがって、生化学的研究は極めて困難である。

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Fig. 1. Luminous land snail, *Quantra striata* (Adult and larval snail)



Fig. 2. Eggs of snail

The major and minor axes of eggs were approximately $1.0 \text{ mm} \times 0.8 \text{ mm}$, respectively.