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Structure of Luminescent Organ of Apogonid Fish, *Siphamia versicolor*

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The first description of the luminescent organ of *Siphamia versicolor* (Smith and Radcliffe) was based on a few specimens deposited in the U. S. National Museum (Iwai, 1958). Since visceral organs of these specimens were considerably destroyed, the connecting duct was indiscernible between the luminescent organ and digestive tract, which was evident in the related species *S. majimai* Matsubara and Iwai as reported by Iwai (1959). Tominaga (1964) noted the duct lying between the luminescent organ and intestine in *S. versicolor* taken from the Ryukyu Islands. Furthermore, Haneda (1965), working with the living fish, found that luminescence of *Siphamia* does not occur by intracellular luciferin-luciferase reaction but occurs by luminous bacteria in the luminescent organ.

Through the courtesy of Dr. Yata Haneda of Yokosuka City Museum, I was privileged to work on new material, and was able to confirm the presence of the duct connecting the luminescent organ with the intestine as is the case with *S. majimai*. The following description gives a morphological account of the luminescent organ of *S. versicolor*.

Twelve specimens used in this study were taken from the coral reefs in the Ryukyu Islands in April, 1964. The specimens, measuring 18–42 mm in standard length, were preserved in 10% formalin.

The luminescent organ, disc-like in shape, lies just below the antero-ventral border of the pyloric limb of the stomach, and touches to the ventral wall of the abdominal cavity at the level of the pelvic girdle (Fig. 1). The organ is very small, 1.9 mm in length, 1.3 mm in width and 0.3 mm in thickness in the 28 mm specimen, but distinct in having black dorsal surface and white ventral surface. The luminescent organ is made up of three major elements: a main luminous body, a reflector, and a duct opening into the intestine. The luminous body consists of glandular tissues perforated irregularly by many small cavities (Fig. 2). A great number of luminous bacteria are present in these small cavities (Fig. 2). The glandular tissues surrounding the cavities receive blood capillaries and are supported by the network of connective tissue by which the septa are formed among the cavities.

The dorsal surface of the luminous body is covered by an opaque layer of fibrous connective tissue. This layer may serve as the reflector of the luminescent organ. Dorsally, the reflector is covered by a thin layer of black pigment cells.

There is a prominent duct connecting the luminescent body with the intestine. The duct is composed of 6–10 canaliculi bound together, except for the anterior portion. At the point about one-fourth from the anterior end of the organ, 2 to 3 canaliculi arise from the dorsal border of the luminous body, and extend to the reflector layer. Immediately behind this point additional canaliculi emerge, and all extend backward in the central portion of the reflector layer. Within the reflector layer the canaliculi are arranged in horizontal row oriented parallel with the blood vessels. Each canaliculus is lined with simple cuboidal epithelium, and is bound to each other by connective tissue. After pene-

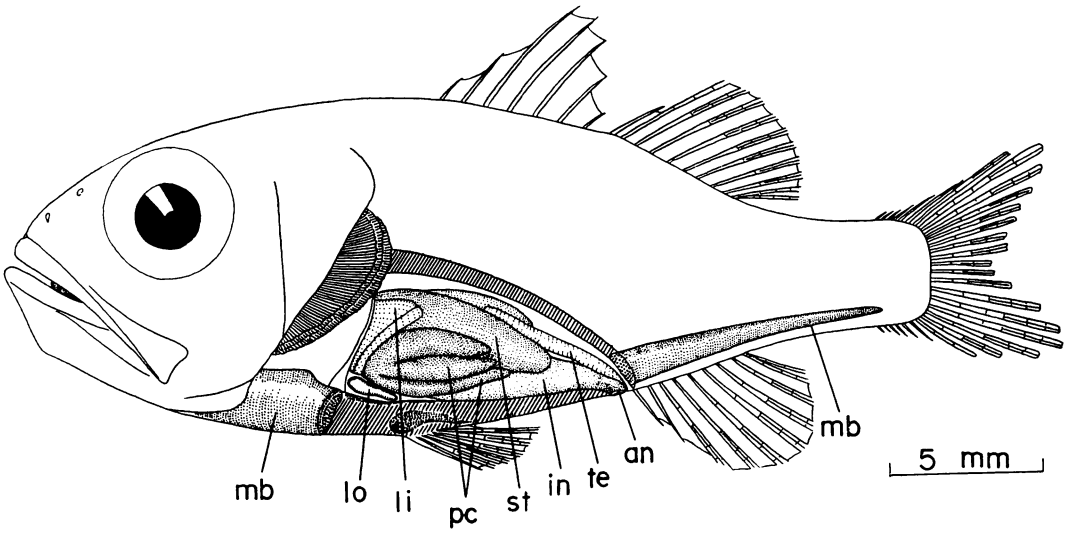

Fig. 1. Lateral view of *Siphamia versicolor* especially showing visceral organs. an, anus; in, intestine; li, liver; lo, luminescent organ; mb, muscle bundle; pc, pyloric caeca; st, stomach; te, testis.

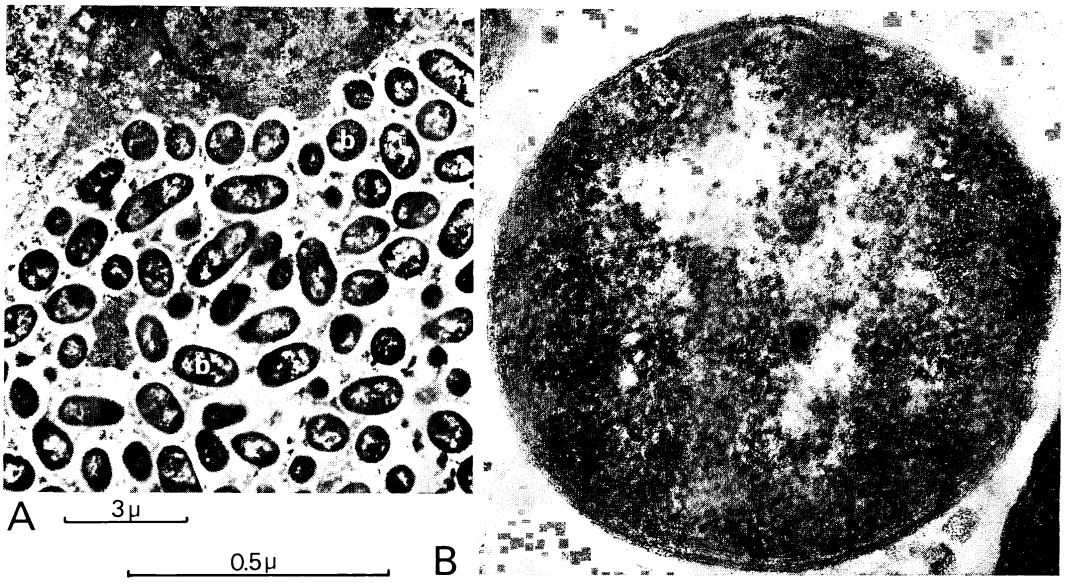

Fig. 2. Electron micrographs of the transversely sectioned luminescent organ. A: Numerous luminous bacteria in a small cavity. B: Cross section of bacterium in luminescent organ. b, bacteria.

trating the reflector layer, the bundle of canaliculi leaves the luminous body, where the canaliculi are bound to form a cylindrical duct. The duct runs posteriorly along the ventral border of the liver. Posteriorly, the duct enters the ventro-lateral musculature of the intestine at the level immediately behind the second loop, and finally opens into the lumen of the intestine. The canaliculi in the duct decrease to 5–7 in number at the posterior portion of the duct just before the opening.

The luminescent organ of *S. versicolor*

was first described as a closed type, lacking the connection with the digestive system (Iwai, 1958). However, from this study, it is evident that a duct is present between the luminescent organ and intestine in *S. versicolor* as pointed out by Tominaga (1964) and Haneda (1965). The case is the same in *S. majimai* described by Iwai (1959).

Based on the histological observations on preserved material, Iwai (1958, 1959) conjectured that the photogenesis is intracellular in the luminescent organs of both *S. versicolor* and *S. majimai*. According to physiological and biochemical studies by Haneda (1965), however, luminescence of *S. versicolor* depends on symbiotic bacteria in the organ. Electron microscope observations revealed that the luminescent organ of *S. versicolor* is not composed of polyhedral photogenic cells but consists of a number of small cavities where luminous bacteria are present. It is much like the condition in the luminescent organ of *S. majimai*, that was erroneously reported as being the mass of polyhedral photogenic cells (Iwai, 1959).

The luminescent organ of *Siphamia* is referable to the indirect type of luminescent system defined by Haneda and Johnson (1962), and resembles that of fishes of the family Leiognathidae in having the opening into the digestive tract and in luminescent mechanism by symbiotic luminous bacteria.

Literature cited

Haneda, Y. 1965. Observations on a luminous apogonid fish, *Siphamia versicolor*, and on others of the same genus. Sci. Rep. Yokosuka City Mus., (11): 1–12, pls. 1–4.

Haneda, Y. and F. H. Johnson. 1962. The photogenic organs of *Parapriacanthus beryciformes* Franz and other fish with the indirect type of luminescent system. J. Morph., 110 (2): 187–198, 8 figs.

Iwai, T. 1958. A study of the luminous organ of the apogonid fish *Siphamia versicolor* (Smith and Radcliffe). J. Wash. Acad. Sci., 48 (8): 267–270, 2 figs.

Iwai, T. 1959. Notes on the luminous organ of the apogonid fish, *Siphamia majimai*. Ann. Mag Nat. Hist., ser. 13, 2: 545–550, 2 figs., pl. 7.

Tominaga, Y. 1964. Notes on the fishes of the genus *Siphamia* (Apogonidae), with a record of *S. versicolor* from the Ryukyu Islands. Japan. J. Ichthyol., 12 (1/2): 10–17, pls. 1–3.

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ヒカリイシモチの発光器の構造

岩井　保

岩井 (1958) はヒカリイシモチの発光器について報告したが，用いた材料が古い固定標本で，内臓の損傷が著しかったために構造の一部を見落し，また，発光は発光細胞によるものであろうと誤った推測をした．その後，羽根田弥太博士の御好意で得た新しい標本について電子顕微鏡による観察を行なった結果，ヒカリイシモチの発光器は発光体，反射層，および発光体と腸管を結ぶ導管からなることが明らかになった．発光体は腺細胞に縁どられた多数の小腔からなり，小腔中には無数のバクテリアが認められる．反射層は結合組織からなり，発光体の背面をおおう．導管は数本の細管の集合体で，発光体背部から発して反射層を縦断し，肝臓の腹面を経て腸管へ開口する．したがって，本種の発光器は消化管と連絡のある開口型発光器といえる．発光は発光器中に生活するバクテリアによるものと考えられる．

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