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The Luminous Organs of Two Species of Leiognathid Fishes Recently Found in Ambon, Indonesia

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(With 7 text-figures 1 table)

アンボンの2種のヒイラギ *Leiognathus hataii*, *Leiognathus aureus* の発光器について

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カリフォルニア大学のスクリップス海洋研究所の 1969 年度，生物発光を目的とする *Alpha Helix* 号によるニューギニア探検に参加した著者等は特に浅海性発光魚を調査したが，その中，ヒイラギ科に属する種類を採集し，その発光状態，発光器の構造，発光細菌について調査した。

ニューギニアにて報告されている 9 種の他に *Leiognathus insidiator* を含めて 10 種を Madang 附近，および，ポートモレスビーの Department of Agriculture Stock and Fisheries の調査船 Tagula によるニューギニア北岸，Manam 火山島附近，Ramu 河河口において採集した。この他，Indonesia の Maluku 諸島，Ambon 湾において，2 種を採集したが，この 2 種は，青緑色の金属光沢のある小形 (50～50 mm) の種類で新種 (ABE, T. and Y. HANEDA 1972) として記載された。本種の発光体は他のヒイラギ類と，その構造は根本的には同じであるが，体長に比して，きわめて大きく，美しい黄金色であった。

発光体内に発光細菌が共生していることは他の種類と同様で，容易に人工培養ができた。

The family Leiognathidae consists of the so-called pony fishes. They are small to moderate-sized carnivorous fishes commonly found in the shallow coastal waters of the tropical and subtropical Indo-Pacific region. All appear to possess luminous organs.

The mode of light production in this group was first investigated by Harms (1928) in *Leiognathus equulus*. The bluish light was shown to originate from a flattened ring of tissue surrounding the esophagus at the point where the latter joins the stomach. Morphological and histological studies of this luminous organ revealed the presence of many rod-shaped bodies and Harms concluded from staining tests that the bodies were luminous bacteria responsible for the light. However, no attempt was made to culture the bacteria from the light organ.

Subsequently, the luminescence in another leiognathid species, *Gazza minuta*, from Palau Islands, Micronesia, was described by Haneda (1937). Beginning in 1938, Haneda studied a variety of species belonging to this group, including *Leiognathus equulus*, *L. fasciatus*, *L. lineolatus*, *L. splendens*, *L. daura*, *L. bindus*, *L. insidiator*, and *L. ruconius* from Micronesia and Sandakan,

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Sabah, Malaysia. The fishes generally showed similar light organ structures. The luminous organs produced a diffused greenish blue light, easily visible externally. Sometimes the luminescence was intermittent. Luminous bacteria were also isolated and cultured from the organs. Control of light intensity appeared to be due to chromatophores. The organ was found to have

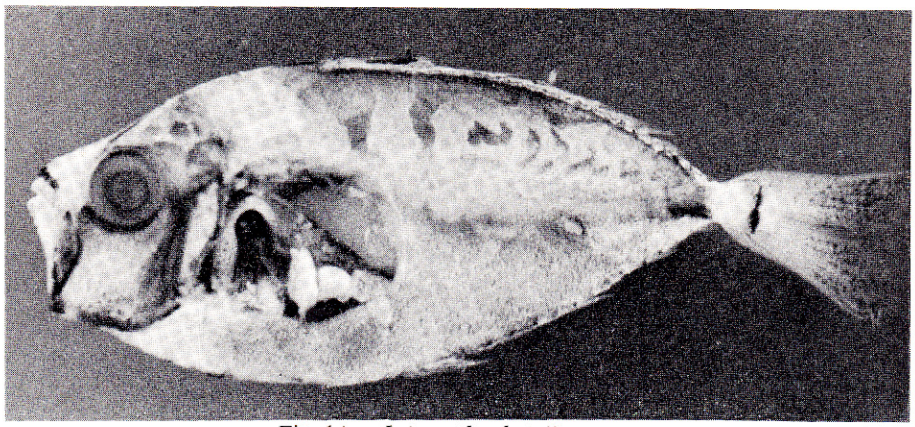

Fig. 1A. *Leiognathus hataii*, n. sp.

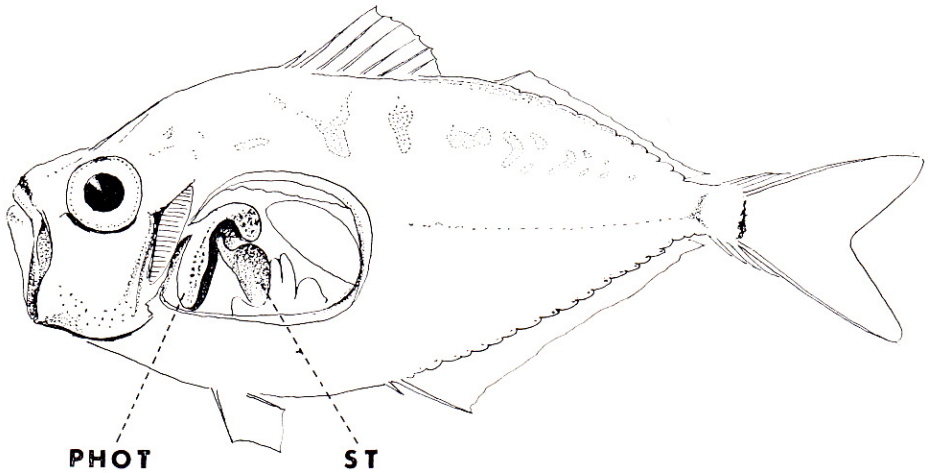

Fig. 1B. Diagramatic figure of luminous body (PHOT) of *Leiognathus* hataii, n. sp. ST: stomack.

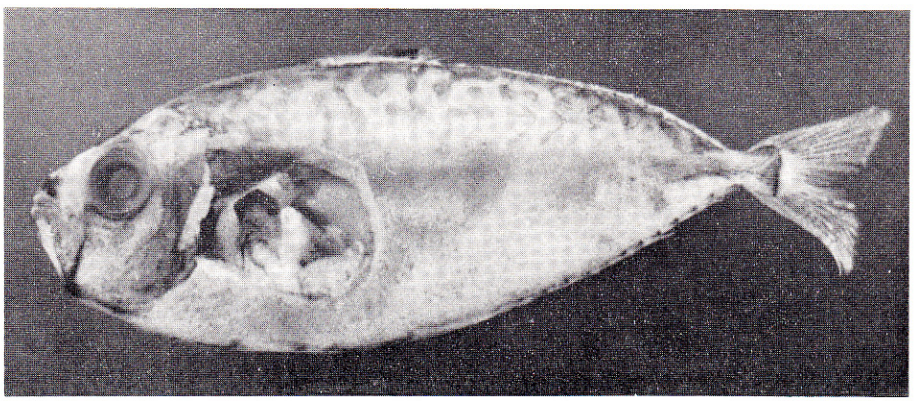

Fig. 2A. *Leiognathus aureus* n. sp.

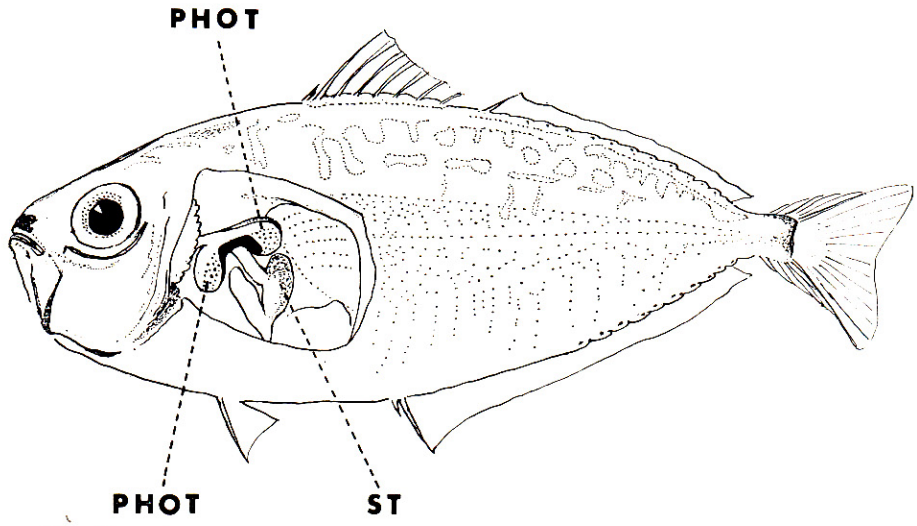

Fig. 2B. Diagramatic figure of luminous body (PHOT) of Leiognathus aureus n. sp.

an opening into the esophagus and it is through this opening that the bacteria appeared to gain entrance initially to infect the organ. The opening may also be used to remove dead bacteria.

The present report lists some leiognathid fishes collected during the *Alpha Helix* 1969 Biological Expedition to New Guinea and describes the light organs of two leiognathid fishes reported elsewhere in this issue (pp. 1–6) by ABE and HANEDA. Of the 9 species previously known to New Guinea, ten were obtained and one species (*L. insidiator*), previously not known to New Guinea, was also collected. The light organs in the above known species have been described before and are not reported here. However, all light organs contained symbiotic luminous bacteria that could be cultured readily on artificial media. The following table gives a list of the specimens obtained.

Table 1.

Serial Number	*Species name*	*Place and date of collection*
1	*Gazza minuta* (BLOCH)	Near estuary of Ramu River, north coast of New Guinea, by R/V Tagula, Oct. 28, 1969
2	*G. achlamys* (JORDAN et STARKS)	〃
3	*Leiognathus insidiator* (BLOCH)	〃
4	*L. ruconius* (HAMILTON-BUCHANAN)	Bay of Madang, north coast of New Guinea, Oct. 21, 1969
5	*L. equulus* (FORSSKAL)	〃
6	*L. bindus* (VALENCIENNES)	Near estuary of Ramu River, north coast of New Giunea, by R/V Tagula, Oct. 28, 1969
7	*L. fasciatus* (LACEPEDE)	〃
8	*L. splendens* CUVIER	〃
9	*L. rapsoni* MUNRO	Bay of Madang, north coast of New Guinea, Oct. 20, 1969.
10	*L. novaehollandiae* MUNRO	〃
11	*L. hataii* ABE and HANEDA	Ambon, Moluccas, Indonesia, Nov. 11, 1969.
12	*L. aureus* ABE and HANEDA	〃

Luminous Bodies of *Leiognathus hataii* and *Leiognathus aureus*

The two last named species *Leiognathus hataii* (Fig. 1. A, B) and *Leiognathus aureus* (Fig. 2. A, B) from Ambon were small (50～55 mm) in size compared to the other species of *Leiognathus*. They resembled *Leiognathus insidiator* and *L. ruconius* (Fig. 3, A, B) in outer appearance. However, they were easily distinguishable from others by their metallic blue-green color in fresh specimens. The luminous bodies were very similar in the two species. Each luminous body was

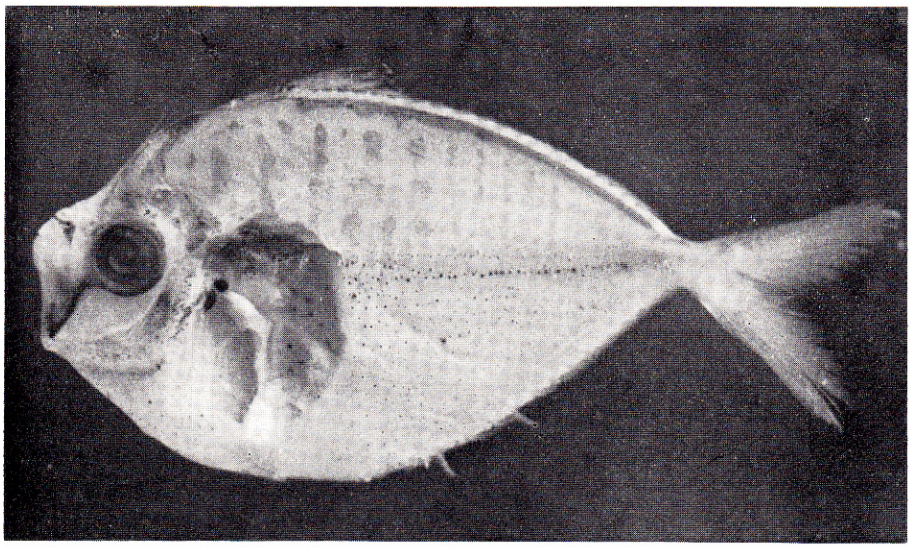

Fig. 3A. *Leiognathus ruconius* (syn. *Secutor ruconius*).

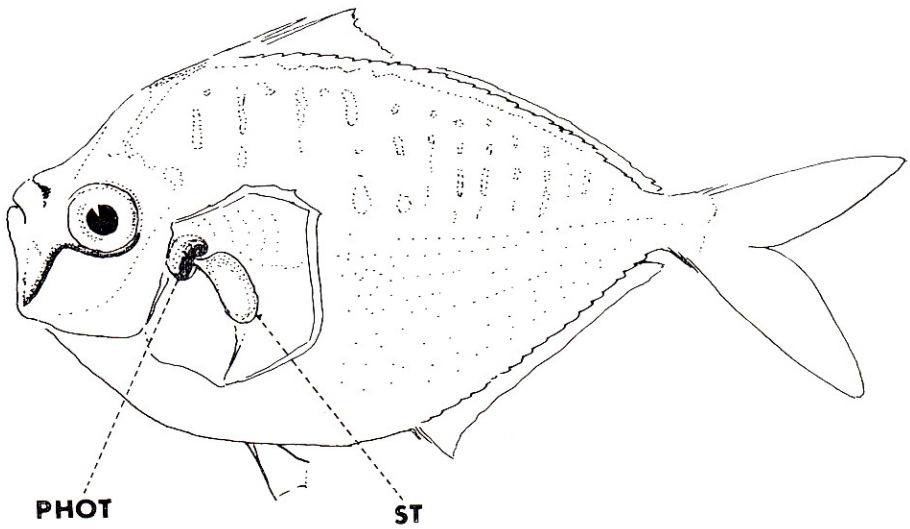

Fig. 3B. Diagramatic figure of luminous body (PHOT) of *Leiognathus ruconius*. ST: stomack.

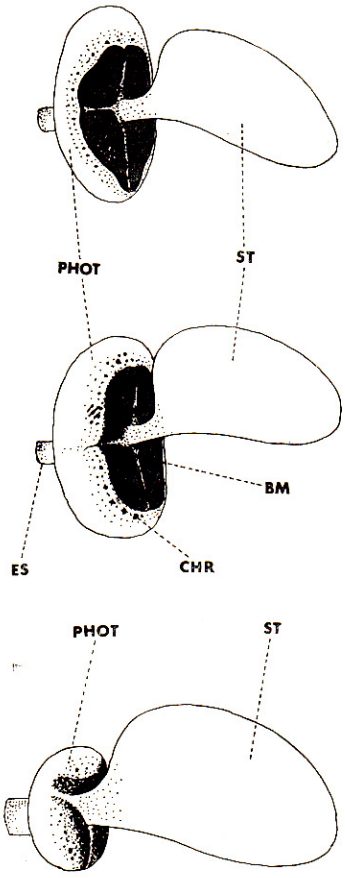

Fig. 4. Diagrametic figures of luminous body and stomack of *Leiognathus halaii* n. sp. (above), *L. aureus* n. sp. (middle) and *Leiognathus ruconius* (below). PHOT: Luminous body, CHR: Chromatophore, BM: Black membrane, ST: Stomack and ES: Oesophagus.

relatively large in relation to body size, but structurally the luminous body resembled the luminous bodys of other species of *Leiognathus*. The luminous body was doughnut-shaped and encircled the esophagus at the juncture of the latter with the stomach. One of the two flat surfaces of the luminous body faced the body cavity and the other faced the thoracic muscles. The surface along the edge of the doughnut was covered by a brilliant golden yellow, transparent membranecontain ing chromatophore granules. In comparison, the membrane in *Secutor* is of a pale lemon yellow color. The contraction and expansion of the chromatophere are apparently used to control the light emission from the organ. The light is passed directly from the lower edge of the doughnut to the outside through the translucent ventro-lateral muscles.

The light from the upper edge of the doughnut-shaped organ, however, is emitted through a small aperture directly into the swim-bladder cavity. The amount of light passing through the aperture is controlled by a movable diaphragm. The inner wall of the cavity is lined with a silvery-white layer of guanine which acts like a reflector. The light is reflected in a ventro-lateral direction to the outside through the translucent muscles. In a specimen of *Leiognathus hataii* 43 mm in total length of the luminous body (Fig. 4) is 5 mm in height, 4.0 mm. in width and 1.8 mm in thickness and a speciment of *L. aureus*, 55 mm in total length the luminous body is 6.0 mm. in height, 5 mm. in width and 2.3 mm. in thichness, while in a specimen of *Leiognathus ruconius* 54 mm total length the luminou body is 3.2 mm, in height, 2.8 mm, in width and 1.8 mm in thickness. Luminous bacteria were readily cultured from both organs on a solid medium containing 30 gm. of NaCl and 23 gm. of nutrient agar dissolved in one liter of water, with the pH adjusted to 7.2-7.4.

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