

On the Luminous Organ of the Anacanthine Fish,
Steindachneria argentea, from the Gulf of Mexico⁽¹⁾

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(With 3 text-figures and 2 Plates)

メキシコ湾の発光魚 *Steindachneria argentea*
の発光器について

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The anacanthine luminous fish, *Steindachneria argentea*, in the Gulf of Mexico was reported by COHEN⁽¹⁾ in 1964.

According to him a doughnut-shaped organ lies in the body wall, outside the peritoneal cavity, and completely surrounds the distal portion of the gut, as in *Paratrachichthys prosthemi* (KUWABARA,⁽²⁾ HANEDA⁽³⁾). In fresh specimens, the side of the body is divided into three sections of unequal width. The lower part of the body is silvery blue and is distinguished by countless parallel dark lines. The same type of skin is also present around the base of the pectoral fin on the side of the head behind the eye, on the isthmus, and on the bottom of the head. The distribution of the striated pigment pattern coincides with the observed areas of luminescence.

A cross section through the body shows the ventral most part of the hypaxial muscle mass distinguished from the other trunk. The septum separating the ventral muscle mass from the dorsal muscles is silvery white ventrally and bears large dark chromatophores dorsally.

In life the septum seems to be a reflector and the ventral muscle mass is translucent and acts as a diffuser of light. COHEN observed the luminescence of this fish by the injection of an adrenalin chloride solution. A faint bluish glow started around the anus and extended posteriorly, forming a luminous streak between the vent and genital opening. Within a few minutes the side of the head and the entire ventral part of the fish emitted light.

According to his description this fish is the only species in the United States which represents an indirect emission type of luminescence. In 1950, the author⁽⁴⁾ first published a paper about the luminous organs, describing a new indirect type of emission luminescence. The luminous body lies inside the fish body and cannot be seen from the outside. The

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reflected light passes through a translucent opaque area of muscles where it appears as a diffuse glow.

It is an interesting fact that the structures of luminous organs of this type of fish in different genera and families are almost the same, even though the luminous substance differs in different families. It is also interesting that this type of fish is found only in the waters of the Pacific coast of Japan, tropical Asia and Australia. The fish having indirect emission type of luminescence are found in the families Leiognathidae, Acropomidae, Trachichthyidae, Apogonidae and Pempheridae.

Steindachneria argentea must be added as an example of this type of luminescence in the Gulf of Mexico. In 1965 the author obtained some preserved specimens of *Steindachneria argentea* from Dr. COHEN and also in October 1966, the author visited Mr. Harvey BULLIS, Director of the Bureau of Commercial Fisheries, Exploratory Fish & Gear Research Base, Pascagoula, Mississippi and talked about *Steindachneria argentea* with him. By his kindness the author obtained several preserved specimens of *Steindachneria argentea* in alcohol and was able to study the structure of this luminous organ.

1. Structure of the luminous organ

Already COHEN has described that the luminous organ of this fish consists of the following components:

a. Luminous body

A doughnut-shaped luminous body lies in the body wall and completely surrounds

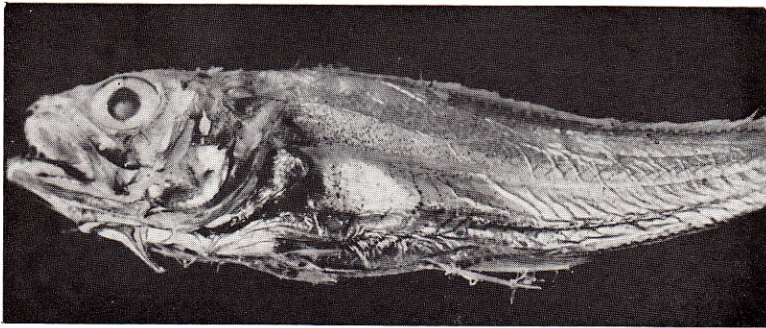


Fig. 1. *Steindachneria argentea*.

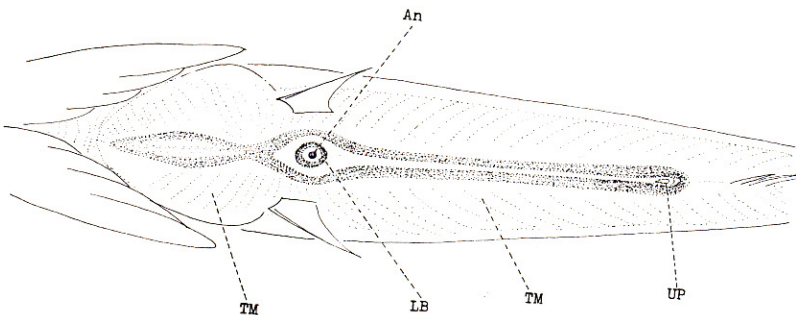


Fig. 2. Outer appearance of luminous organ of *Steindachneria argentea*.
LB, Luminous body; An, Anus; UP, Cloaca; TM, Translucent muscle.

the distal portion of the anus. This organ is very similar to that of *Paratrachichthys prosthemi*. This is composed of glandular tissue enclosed within a thick black membrane.

b. Transparent, gelatinous material

The body wall along a midsagittal section between the anus and the genital area shows a transparent gelatinous material. The gelatinous material may serve as a lens or diffusor of light of the luminous body.

c. Translucent muscle mass

The ventral muscle mass of this fish resembles the cloudy opaque translucent muscle bodies of *Paratrachichthys prosthemi*, *Siphamia*,⁽⁵⁾ *Acropoma*⁽⁴⁾ and *Leiognathidae*⁽⁴⁾. This muscle tissue is cloudy translucent and diffused light will pass through it easily to the end of the muscle tissues.

d. Reflector

A cross section through the body shows that the septum separating the ventral muscle mass from the dorsal muscles is silvery white ventrally and bears large black chromatophores dorsally. It seems that this septum is a reflector resembling the septum of the fish of the families *Leiognathidae* and *Acropomidae*.

2. The outer appearance of the luminous organ

The ventral view of the luminous organ of *Steindachneria argentea* resembles the luminous organ of *Coelorrhynchus*⁽⁶⁾ belonging to the family *Macrouridae* as shown in Fig. 2. However the structure of both luminous organ is quite different.

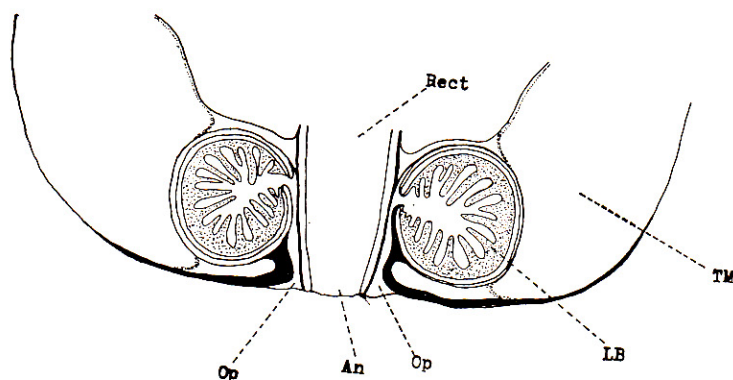


Fig. 3. Transverse section of luminous body of *Steindachneria argentea*.
LB, Luminous body; Op, Opening of luminous body; Rect, Rectum;
An, Anus; TM, Translucent muscle.

As the examined specimens were preserved in alcohol, no culture test of luminous bacteria from the luminous body could be performed, but the structure of the doughnut shaped luminous body is very much like that of *Paratrachichthys prosthemi* and from a histological study of the organ by electron microscope the author has come to the conclusion that the glandular bodies in the organ are bacteria as shown in Fig. 5. It would be most important to confirm this with bacteriological studies of living fish.

1964年 Cohen はメキシコ湾の大陸棚に普通にみられる魚 *Steindachneria argentea* の発光と発光器について報告した。材料は Pascagaula にある Bureau of Commercial Fisheries の試験船 Oregon の底曳網でミシシッピデルタで得られたものである。彼によると、発光体は肛門の周囲をとりかこむドーナツ状の器官で、体側の下方 1/5 の筋肉が半透明で光をよく拡散する性質があり、ハリダシエビス *Paratrachichthys prosthemi* の発光器と似ていることを指摘し、生魚にアドレナリンを注射して、急激な光の明滅を観察している。この形式の発光魚、即ち発光体が体内または体の一部にあって、胸部及び腹部の筋肉が半透明になっていて、発光器の光がその筋肉を通じて出る形式の発光器を著者は間接照明の発光器と呼んだ、この形式の発光魚はヒイラギ科 *Leiognathidae*、ホタルジャコ科 *Acropomidae*、ヒカリイシモチ属 *Siphamia*、ツマグロイシモチ *Apogon ellioti*、キンメモドキ *Parapriacanthus ransonneti*、ハリダシエビス *Paratrachichthys prosthemi* などにみられ、いずれも日本、熱帯アジア、オーストラリアの種類で、欧州、アメリカには見られなかった。従って *Steindachneria argentea* はアメリカで発見されたこの形式の発光魚の最初のものである。著者はこの魚の発光器に非常に興味を持ち、Dr. COHEN の好意により送られた本魚の標本について発光器の構造をしらべていたが、1966年10月、Pascagaula の Bureau of Commercial Fisheries の所長 Harvey R. BULLIS 氏をたずねる機会を得、本魚について種々、情報を得ると共に、新鮮なアルコール漬標本3個体の寄贈を受け、本魚の発光器と、他の間接照明型の発光器とを比較してみた。

Steindachneria argentea の発光器

本魚の外観は Fig. 1, 2 に示すように、ソコダラ科 *Macrouridae* の発光魚に似ている。魚の外観そのものも非常によく似ているが、発光器の外観、位置まで殆んど同様である。魚そのものは勿論、縁の遠いものであり、発光器の構造そのものも異なっている。多くの魚は肛門と泌尿、生殖腺開孔が接近しているのに反し、本魚はその間隔が体長 220 mm、の魚で 24 mm、にも達している。*Coclorhynchus* や *Hymenocephalus* では発光腺は肛門の近くの直腸から分枝したシャクシ状の盲管であって、長い導管の先がふくらみ発光体となっている。本魚の発光器も外観では *Coelorhynchus* や *Hymenocephalus* のそれようであるが、先端のふくらみのようにみえる所に肛門があり、発光体は肛門をとりまくドーナツ形の器官であり、正中線上に長い導管のようにみえる黒い線は単に、肛門と泌尿生殖腺間の皮膚上にある黒色素斑にすぎない。

本魚の発光器は (1) 肛門をとりかこむドーナツ状の黒い発光体、(2) 腹部及び胸部腹面にある半透明乳白色の筋肉、(3) 反射層よりなっている。

発 光 体

ドーナツ状の発光体は、体長 220 mm の魚では直径 5.0 mm、太さ 1.5 mm で表面に黒色素斑を多数包む層がある。この発光体の構造は、*Paratrachichthys prosthemi*、*Leiognathidae* の発光腺と酷似し、黒色素斑も同様である。COHEN は生魚にアドレナリンを注射し、急激なる明滅を認めたと言うが、*Leiognathidae* に属する魚は、発光腺内に発光バクテリアが共生するが、手でつかむと、急激な明滅をする。これは発光腺を包む膜の中にある黒色素斑の伸縮によるもので恐らく本魚の場合も同様であろう。発光体の内容については恐らく発光バクテリアであろうと想像出来るが、生魚を得ることが出来ず、培養試験を行なえなかつたので確定的なことを言えないが電子顕微鏡像を発光バクテリアと共生するヒイラギ類のそれと比較してみると、殆んど構造が同じであるので発光の本態は共生する発光バクテリアであることが考えられる。

乳白色半透明の腹面の筋肉組織

腹面の腹部筋肉，胸部竜骨筋は前述のように乳白色，半透明で光をよく透過拡散する性質がある。魚の断面をみると，ホタルジャコ類 *Acropoma japonicum*, *A. hanedai*, *Leiognathidae*, ヒカリイシモチ *Siphamia versicolor* の場合と全く同様で，光を透過拡散し，発光体の光りを魚体の腹面一帯をぼんやり光らせるための発光器の一部と考えられる。

反 射 層

魚の断面をみると，乳白色半透明の筋肉組織と他の筋肉組織の境に白色不透明の層があり，その背後に黒色色素層がある。これは光を反射させるための反射器であると同時に光が魚の背部に達するのを防ぐ作用を持っている。ホタルジャコ *Acropoma*, *Leitgnathus* と全く同様である。

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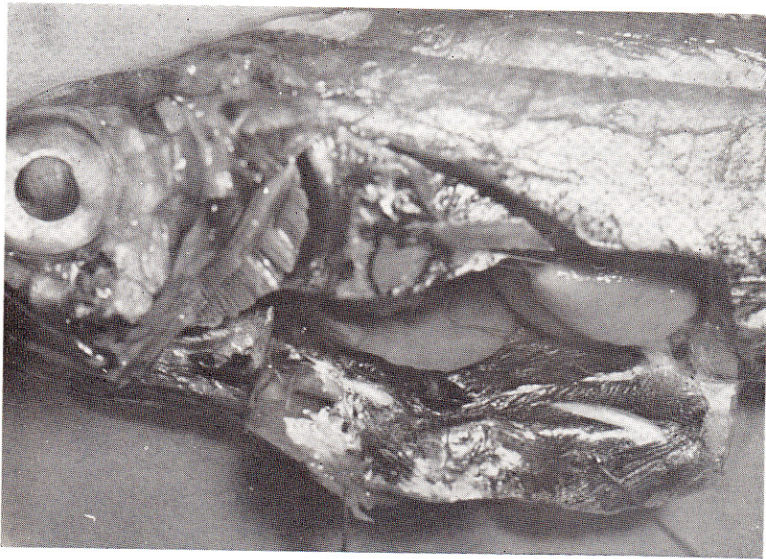
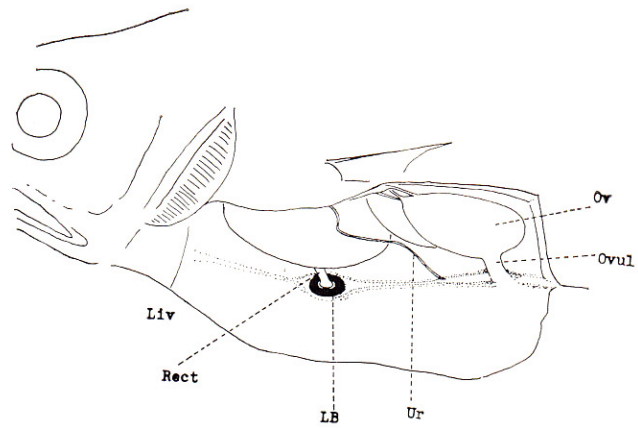


Fig. 4. Anatomical figure of *Steindachneria argentea* showing luminous body and intestine.
LB, Luminous body; Rect, Rectum; Ov, Ovary; Ovul, Ovulation canal; Ur, Ureter; and Liv, Liver.

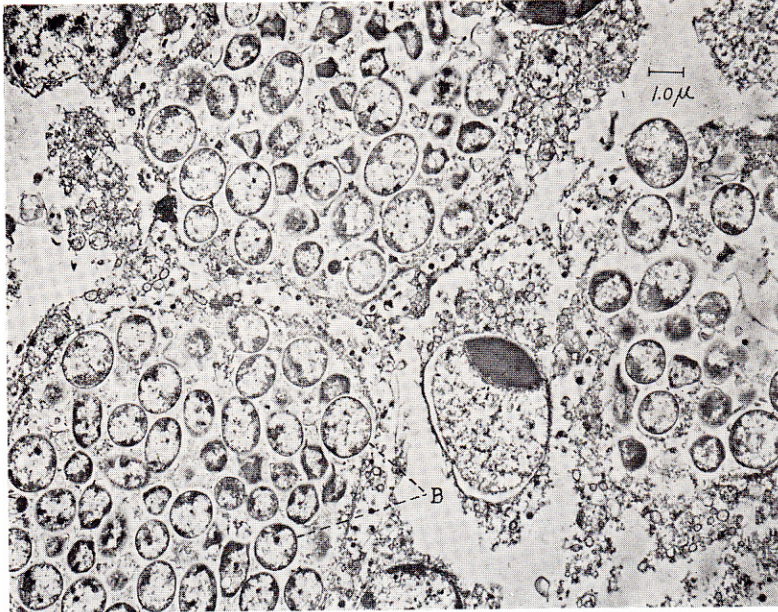


Fig. 5. Electron microscopic figure of the luminous body of *Steindachneria argentea*.
×5,000. B, Bacteria

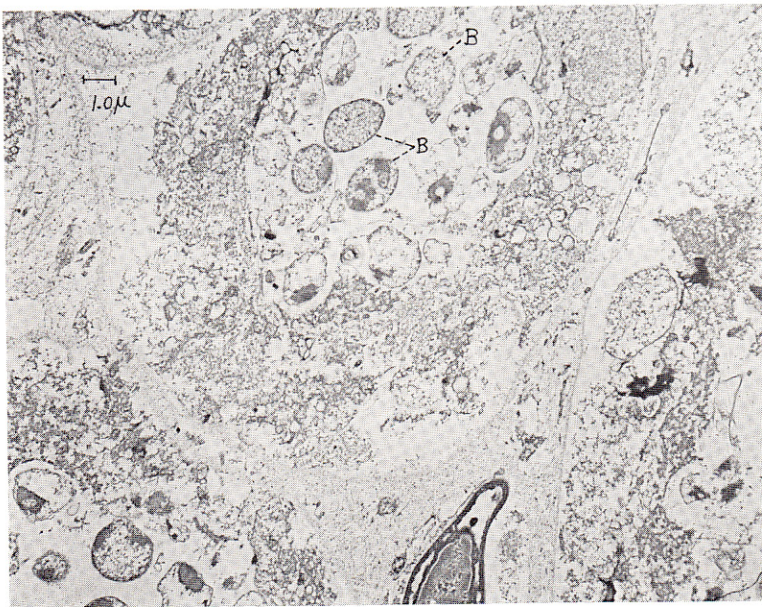


Fig. 6. Electron microscopic figure of the luminous body of *Leignathus argenteum*.
×5,000. B, Bacteria